

FY2013 Specialty Crop

Block Grant Program – Farm Bill

Idaho State Department of Agriculture

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Table of Contents

Idaho Apple Commission	
In Search of Suitable Rootstocks to Improve Yield Efficiency, Precocity, Mineral Nutrient Uptake, and Fruit Quality of Apples in Idaho	3
Idaho Bean Commission	
Slow Release Nitrogen Trials for Dry Bean Production	7
Idaho Bean Commission	
Trials of Peruano Dry Bean Seed in the U.S. and Mexico	13
Idaho Grape Growers and Wine Producers Commission	
Increase the Exposure of the Idaho Wine Industry	15
Idaho Nursery & Landscape Association	
Plant Something Idaho Marketing & Promotion Campaign	21
Idaho Potato Commission	
Monitoring Potato Psyllid Biotypes in Idaho	25
Idaho Preferred	
Promoting Specialty Crops through Advertising and Retail Marketing	30
Sunnyslope Wine Trail Group	
Sunnyslope Wine Trail	35
University of Idaho	
Eradication of the Necrotic Isolates of PVY from Idaho Potato.....	40
USDA-ARS	
Impact of Grapevine Viruses on Idaho Grape Quality	46

In Search of Suitable Rootstocks to Improve Yield Efficiency, Precocity, Mineral Nutrient Uptake, and Fruit Quality of Apples in Idaho

Subrecipient

Idaho Apple Commission (IAC)

Project Summary

The presence of excellent climate and soil conditions make southwestern Idaho an outstanding region for production of high quality apples. However, the increasing world population and decreasing suitable land and water mandate establishment of high-density orchards. The use of size-controlling rootstock is absolutely essential for establishment of high-density orchards. Rootstock can influence a wide range of physiological characteristics and tree performance of the scion cultivar, including tree vigor, precocity, fire blight and other disease susceptibility, mineral nutrient uptake, and fruit quality attributes. Rootstock performance needs to be tested in each climate before it is recommended for commercial plantings. To achieve the effect of rootstocks on the scion fruit quality, yield and minerals, 'Aztec Fuji' apple trees were purchased from Willow Drive Nursery, Washington in spring of 2010. Number of trees in each rootstock was different, ranging from one to 12 trees.

Project Approach

For this project, trees were planted at 6 x 14 ft spacing in April 2010 and trained into tall spindle. Training continued in 2011 and 2012. Feathers were tied at a horizontal position during June 2011 and 2012. An 18-mm drip line was installed in a 10-cm trench (subsurface), 40 cm away from and parallel to the tree row at each of the north and south sides of the tree row. Lines were connected to a pressure regulator to keep the water pressure constant at 1.41 kg.cm^{-2} . Pressure compensating emitters were spaced at 45 cm on each line, and each emitter delivered 0.92 Gal water per hour. Pressure compensation ensured consistent flow from each inline emitter throughout the entire length of tubing and the emitter design prevented debris from clogging emitters for maximum performance. The drip line on the north side of the tree was "off-centered" with the line in the south side to provide better water coverage. Trees in this system were irrigated twice a week at 100% of daily ETc. Pressure-treated wooden posts were installed in this orchard. Each post was placed 3 ft in the ground and 11 ft above the ground. Trees were trained into high spindle system and fastened to four wires. The design in this experiment is randomized complete block design with 4 replications. Each replication had a varying number of trees. Trees of each rootstock in each block were arranged according to the NC-140 protocol. Each tree received 80 g actual N in 2011 and 60 g actual N per year after 2012.

Leaf samples were collected, washed and dried for mineral analysis in July every year. Yield, number of fruits per tree, and fruit quality attributes at harvest and after storage in were measured each year.

Goals and Outcomes Achieved

'Aztec Fuji' apple yield efficiency, fruit quality attributes, and leaf minerals varied significantly among rootstocks. Rootstocks had a major effect on tolerance to the cold that occurred during the freezing front that on November 2014, while trees were not acclimated yet. Several Geneva series rootstocks and Bud series showed promising results. In general, the following results were archived from the 2010 and 2014-Planting projects:

2010-Fuji Apple Planting:

1. Averaging over 2010 through 2015, trees on B.70-20-20, B.67-5-32, CG.3001, B.64-194, PiAu51-11, CG.5222, and CG4004 had the largest trunk cross sectional area (TCSA) but those on B.7-20-21 and B.71-7-22 and CG.4003 had the smallest TCSA.
2. Cumulative yields in trees on CG.4004, G.41, CG.3001, and G.935N were higher while in trees on PiAu9-90 and B.71-7-22, CG. 4003 and B.7-20-21 were lower than trees on all other rootstocks.
3. Number of fruit per tree often correlated with the total yield per tree in most rootstocks in each year. In 2014, trees on CG.4004, G.41, G.935N, M.26EMLA, and CG.3001 had higher number of fruit per tree.
4. Cumulative yield efficiencies (Cum. 2011-2015 yield in kg/TCSA of 2015) in trees on G.935N, CG4214, CG.2034, M9T337, and B.9 were highest, while trees on B.70-20-20, B.7-20-21 and PiAu9-90 were among the lower ones.
5. Fruit size varied widely among trees on different rootstocks. Averaging over 2012-2015 periods, trees on CG.3001, CG. 4004, CG.5222, G.41N, B.70-20-20, M.26.EMLA, and PiAu51-11 had the largest fruit while those on B.7-20-21, CG.4003 and PiAu9-90 had smallest fruits.
6. Averaging 2012-2015, fruit color was the best in trees on CG.4814 and CG.5087 rootstocks.
7. Fruit from trees on B.7-20-21 had the highest soluble solids concentration (SSC) and firmness because of their smallest size. Trees on B.70-20-20 were among those with the least color, SSC and firmness during 2012-2015.
8. Fruits from trees on G.935N, G.935TC, Supporter 3, and CG.4214 had more advanced starch degradation pattern (SDP) while those on CG.5087 had the lowest SDP than those on other rootstocks when values were averaged over 2012-2015.
9. Trees on B.20-20-21 and CG.5087, and G.11 had higher concentrations of leaf N but those on CG.2034, PiAu990, and Supporter 3 had lower leaf N than those on other rootstocks over 2012-2014.
10. Trees on B.64-194 and B.70-20-20 had higher concentrations of leaf K but those on G.935T, G.935N, and G.4003 had lower leaf K than those on other rootstocks over 2012-2014.
11. Differences also existed among rootstocks for some of the scion leaf microelements, fruit russet, bitter pit, watercore, stain and stem-end cracking.
12. It was found that 622 to 1210 trees per acre on each of the M.9337, Geneva 935, Geneva 41, Geneva 4004, Geneva, 11, and Bug 9 rootstock can be planted and increase the yield to about 80 to 90 tons per hectare, easily. This finding is perfectly in line with the original goal and anticipation.

13. Water consumption with drip system in this study resulted in 38-40% less water consumption as compared to the sprinter system. This finding is also extremely important as water shortage is beaconing a major problem world wide.

2014-Fuji Apple Planting: An experimental orchard of 'Aztec Fuji' apple on various rootstocks were established at the University of Idaho, Parma Research and Extension center on March 3, 2014. Trees for the new 2014 planting were not in optimum conditions when received. Feathers were either dead or broken with severe die back. Trees started to leaf out two week late and did not start to grow until mid-summer. These leaves were small and resembled severe zinc deficiency. Trees were fertigated by high rates of zinc and urea to keep them alive. Tree growth improved by the end of growing season. Trees on V.5 and V.6 were more vigorous than those on many other rootstocks during 2014 growing season. However, we had a severe and sudden freeze on November 17 and 18, 2014. During those nights, temperatures plunged down from 55-65° F daytime to -5° F at night and caused severe damage on numerous trees and nursery stocks in the region. Severe damages on most 'Aztec Fuji' trees on "V" series rootstocks was observed. Some of these damaged trees grew during June and July 2015, but finally collapsed during August and September 2015. In March 2016, branches that grew from a lower part of the damaged tree (but above the bud union) were trained into a tall spindle system. These trees had excellent growth in 2016 and are recovering at this time. Trees on rootstocks other than V series such as Geneva series seemed to be slightly better than others. Yield and growth measurements were taken and cold damage was assessed. Leaf samples were taken for mineral analysis and fruit samples were taken in early October 2016 and analyzed for quality attributes at harvest and after storage.

Beneficiaries

Growers of Idaho and the intermountain west region are following the performance of these rootstocks closely and will be using superior rootstocks in their plantings.

At least 65 Idaho growers are adapting the rootstocks that we recommend in this study and this change may increase the net income of our growers by at least by 35% to 40%

Lessons Learned

Several rootstocks, including Bud 7-20-21 should not be planted because they induce severe dwarf trees. Several Geneva and other apple rootstocks, including Geneva 935 and Geneva 41 seem to be suitable for climate and soil conditions of southwest Idaho.

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Additional Information

Scientific Publications:

1. Fallahi, E., Fallahi, B. Shafii. 2016. The Influence of Apple Rootstock Genotypes on the Cultivar Tree Performance, Productivity, Fruit Quality, and Mineral Nutrition. HortScience. 112.

2. Wesley, A., Robinson, T., B. Black, R. Crassweller, E. Fallahi, M. Parker, R. Parra Quezada, and D. Wolfe. 2016. Budagovsky, Geneva, Pillnitz, and Malling apple rootstocks affect 'Fuji' performance over the first five years of the 2010 NC-140 Fuji Apple Rootstock Trial. J. Amer. Pom. Soc. In Press.

Scientific and outreach oral presentations:

Several presentations were offered from the results of our rootstock study during 2015 and 2016. These presentations were educational to scientists and growers in Idaho and Washington. Among these presentations were:

1. Fallahi, E. November 2015. NC-140 Fuji/Rootstock Progress Report. Annual conference of NC-140, Davis, CA attendance 41.
2. Fallahi, E., November 12-13, 2015. NC-140 Fuji/Rootstock Report. Annual Conference of the Idaho State Horticultural Society, Nampa, Idaho; Attendance 115.
3. Fallahi, E. March 8, 2016. Training on Growing Apples on Different Rootstocks. Idaho apple growers. March Tour, 58 in attendance.
4. Fallahi, E. September 16, 2016. Performance of Apple Rootstocks under Intermountain West Conditions. University of Idaho Pomology Program Fruit Field Day, Growers and Public audience. Attendance 925.

Slow Release Nitrogen Trials for Dry Bean Production

Subrecipient

Idaho Bean Commission (IBC)

Project Summary

The intended purpose of this project was to evaluate the response of dry bean plants to nitrogen fertilizers. In the past few years new products have come to market that theoretically allow nitrogen to be more available to plants later in the growing season by slowing the release of the nitrogen sources from the fertilizer prill or by reducing volatility of the nitrogen. There has been very little research conducted on slow release nitrogen products in Idaho and the University of Idaho does not have a recommendation for using these products in dry bean production. The Idaho Bean Commission (IBC) approached University of Idaho Extension faculty to see if they can help determine the efficacy of slow release nitrogen products for dry bean production and if possible to create recommendations for the use of these products.

To address this need, Amber Moore, Steve Hines, and Joel Packham from the University of Idaho worked in cooperation with the Idaho Bean Commission to create a two-year, two location research study, designed to evaluate the effects of various nitrogen fertilizer products, application rates, and application timings. The studies were conducted at the UI Parma Research Station in Parma, Idaho, and grower Dan Shewmaker's crop fields in Kimberly, Idaho in 2014 and 2015. Petiole nutrient and bean yield information from both locations was collected, analyzed, and summarized.

Project Approach

A grower survey was conducted by IBC in early 2013 to determine information gaps in dry bean production management. Over 200 Idaho bean producers responded. Fertilizer management was one of the top challenges that was identified. Amber Moore met with several dry bean commissioners to determine the most critical fertilizer information gaps seen by the Idaho bean industry, in order to narrow in on specific research questions that could be addressed through field research trials. All of the commissioners described a need recent, localized information on dry bean yield response to N fertilizers.

Objectives:

1. To determine if a single pre-plant incorporated fertilizer application of nitrogen fertilizer is sufficient for season long nitrogen source in dry beans.
2. To determine if slow release products applied to nitrogen fertilizer sources are effective in providing more consistent season long nitrogen supply when compared to conventional nitrogen fertilizer sources.
3. To determine if there is a difference between selected slow release products.

4. To determine if a mid-season foliar application of nitrogen is a cost effective method for supplying fertilizer to dry beans.

The study was conducted at the UI Parma Research Station in Parma, Idaho, and grower Dan Shewmaker's crop fields in Kimberly, Idaho in 2014 and 2015. Othello variety pinto beans were grown at the Parma location; pink beans (variety UI 537) were grown the Kimberly location. Both Othello pintos and UI 537 pinks are indeterminate vining type varieties. Irrigation method was furrow irrigation for all study sites.

Randomized complete block design with four replications in 2014 and five replications in 2015, was used. The plots were 25 feet long with a four-row width in 2014 and six-row width in 2015. The center two rows were harvested for yield in 2014; the center four rows were harvested in 2015. All fertilizer treatments were applied at three rates (33%, 66%, 100%) based on current UI recommendations.

The fertilizer treatments were as follows:

1. Urea (20 lb. N/acre pre-plant, the rest as top dress)
2. Urea (20 lb. N/acre pre-plant), the rest as foliar N (in-season) (2014 only)
3. Urea (all pre-plant)
4. ESN (all pre-plant)
5. 25% Urea, 75% ESN (all pre-plant) (2014 only)
6. 50% Urea, 50% ESN (all pre-plant)

All pre-plant applications were applied by hand and incorporated prior to planting. Top dress and foliar applications were made by hand at the appropriate growth stage. Top dress application was made just prior to final cultivation and foliar applications were made at R1 stage and applied in mix with Headline fungicide. Petioles were sampled at the two-leaf stage in 2014, and at early bloom in both years. Petioles were analyzed for all agronomic nutrients. The IBC provided additional funds to pay for petiole analysis.

Fertilizer treatments had no significant effect at the $p = 0.10$ level on any of the petiole nutrients measure at either location in either year. Also, due to concerns with the presence of nightshade berries in yield samples collected from Parma in 2014, this data will not be shown or discussed.

Othello pinto bean yields were not significantly impacted by the addition of fertilizer N at the Parma location in 2015 (table 1). Possible explanations for the lack of the effect include 1) the Othello pinto bean variety is an efficient N fixer, therefore not responding to additions of fertilizer N, and/or 2) soil N levels were too high (83 lb N/acre, 0-2 ft.) to trigger a N response to additional applications of N.

Pink bean yields at the Kimberly location were not significantly impacted by the addition of fertilizer N treatments in 2014 (table 2). The 2015 yield response to treatments were significant at the $p = 0.10$ level, but not at the 0.05 level (table 2). This was unexpected, as soil N levels were relatively high for a dry bean crop (120 lb N/acre, 0-2 ft.) Yields trended upward in 2015 up to 54 lb N/acre for all treatments. The highest N rate in 2015 of 80 lb N/acre showed no additional benefit, and may have even decreased yields for the ESN coated urea treatment. It is possible that the high N rate coupled with more N release later in the season increased vegetative growth and decreased pod set in this indeterminate variety. The highest yields in 2015 were in response to the ESN coated urea and 50/50 urea/ESN urea treatment, both at the 54 lb N/acre rate. Growers still need to consider cost before working with ESN to determine if the added costs of ESN are economically feasible.

Table 1. Total bean yield in 2015 for Othello pinto bean (Parma site) and pink bean (Kimberly site), as affected by N fertilizer application rate, method, and type. All fertilizer was applied as a pre-plant application, unless otherwise stated.

Location	Treatment	N fertilizer rate (lb N/acre)		
		27	54	80
		Yield (lb/acre)		
Kimberly, Idaho Pink bean Soil N = 120 lb N/acre (0-2 ft.) p-value = 0.0802	Urea	3,949 bc	4,132 abc	3,995 abc
	Urea/ESN-coated Urea 50/50 blend	4,013 abc	4,276 a	3,837 c
	ESN-coated Urea	4,043 abc	4,244 ab	4,153 ab
	Top-dressed Urea*	4,100 abc	4,157 ab	4,080 abc
	Control (No N applied) --- 3,950 bc			
Parma, Idaho Othello pinto	Urea	3,418	3,169	3,144
	Urea/ESN-coated Urea 50/50 blend	3,507	3,504	3,408
	ESN-coated Urea	3,392	3,565	3,359

bean	Top-dressed Urea*	3,206	3,275	3,567
Soil N = 82.8 lb N/acre (0-2 ft.)	Control (No N applied) --- 3,350			
p-value = 0.8402				

*20 lb N/acre applied at preplant, with the remaining fertilizer applied at the two leaf stage

Table 2. Total bean yield in 2014 for pink bean (Kimberly site), as affected by N fertilizer application rate, method, and type. All fertilizer was applied as a pre-plant application, unless otherwise stated. (Parma site data not shown, due to concerns with nightshade berries confounding the yield results).

Location	Treatment	N fertilizer rate (lb N/acre)		
		27	54	80
		Yield (lb/acre)		
Kimberly, Idaho Pink bean Soil N = 40 lb N/acre (0-2 ft.) p-value = 0.2362	Urea	3,657	3,709	3,643
	Urea/ESN-coated Urea 50/50 blend	3,909	3,974	3,792
	Urea/ESN-coated Urea 25/75 blend	3,732	3,508	3,831
	ESN-coated Urea	3,587	3,341	4,002
	Top-dressed Urea*	3,829	3,813	3,779
	Foliar N fertilizer**	3,669	3,758	3,631
	Control (No N applied) --- 3,473			

*20 lb N/acre applied at preplant, with the remaining fertilizer applied at the two leaf stage

**Foliar N treatments – 20 lb N/acre was applied at preplant. Kugler KQ-XRN (28-0-0) was applied as a foliar spray at the bloom stage at rates of 0.7, 1.3, and 2.0 gal/acre.

Goals and Outcomes Achieved

Based on study findings, the following recommendations were developed:

- 1) Data collected from this study did not justify the need to change current UI fertilizer recommendations for N fertilizer application rates and method for irrigated dry beans grown in Southern Idaho.
- 2) This use was not recommended of foliar N fertilizer products based on our findings, as there was not a significant yield increase response to N foliar fertilizers.
- 3) Finally, it is not recommended that growers use petiole sampling for estimating bean plant nutrient status, as there was no significant link between petiole nutrient concentration and bean yield for any treatments over all three site-years of data collected.

Having these recommendations in place meets the project goals of providing further guidance to Idaho dry bean growers on best methods for N management in their crop.

Beneficiaries

This project benefits Idaho dry bean growers, crop consultants, and N fertilizer industries in Southern Idaho.

It has been estimated that there are around 500 bean growers in the state of Idaho and 30 dealers. Unfortunately a hard number of growers is difficult to obtain as beans are a rotation crop and it varies from year to year as a result. One of our collaborators, Steven Hines, presented findings and results at our annual Bean Schools in 2016. The events are held in our two most populated bean growing areas; the first was at the Red Lion in Twin Falls on Jan. 27, 2016 and was attended by 92 growers and dealers. The second event was held in Nampa at the Hampton Inn Jan. 28, 2016 and was attended by 108 growers and dealers, so we had a very great percentage of involved industry people turn out to hear our results (around 40%).

Lessons Learned

There were several valuable lessons learned regarding N fertilizer and dry bean production during the course of the two-year study.

- 1) Manage weeds carefully – Yield data collected in 2014 from the Parma location was compromised by intensive weed pressure. While weeds were managed earlier in the season, the presence of bindweed and nightshade likely contributed to early shattering, lowered yields, and a decreased response to the N fertilizer treatments. Efforts were made in 2015 to target fields with low weed pressure, and to stay ahead of weed issues. Don Tolmie assisted with this effort by providing a rogue crew to help with late season hand-weeding at the Parma location in 2015.
- 2) Topdress N fertilizer timing - Another minor issue was the timing of the topdress fertilizer N application in Parma, 2014 (applied at the two leaf stage). As the plots had not yet been irrigated, undissolved N fertilizer prills from the preplant treatment applications could still be

seen, indicated that they were not yet dissolved or available for plant uptake. Efforts were made in 2015 to delay top-dress applications until after the first irrigation event had occurred.

- 3) Target fields with extremely low N status – As beans use a relatively small amount of N, fields with extremely low levels of soil N are needed to evoke a N fertilizer response. Achieving levels this low may require planning one or even two years in advance, by designating a specific field for a bean N study, not applying N fertilizers for several years, and growing N mining crops (like wheat or corn).
- 4) Larger plots and more replications – To catch subtle dry bean yield response to treatments, we discovered that it was necessary to use more replications (at least five, six if possible), and larger plot size (minimum 4-yield rows within the plot), and longer plots (at least 30 ft., longer if possible) than is used for corn, small grains, and other common Idaho crops.

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Trials of Peruano Dry Bean Seed in the U.S. and Mexico

Subrecipient

Idaho Bean Commission (IBC)

Project Summary

Dry beans with yellow seed color represent an emerging market class with increasing demand in the U.S. These are variously referred to as yellow, Peruano, Azufrado, or Mayocoba beans. As Hispanics from Sinaloa have emigrated to the U.S., imports of Peruanos also increased. Bean dealers and growers in the U.S. would like to produce yellow types. Despite being of tropical origin, yellow beans are somewhat adapted to production at temperate latitudes. Plants have determinate (bush) growth habit and are not sensitive to day-length induced flowering, allowing production with normal yields under Idaho growing conditions.

Two disease resistances considered essential for bean production in the Western U.S. are bean common mosaic (BCMV) and the related bean common mosaic necrosis (BCMNV) viruses, and beet curly top virus (BCTV). Resistance to BCMV and BCMNV is required for seed production whereas BCTV resistance is necessary for field production in the Western U.S. Peruano beans generally lack these resistances.

This project received Specialty Crop Grant funding in 2009 and 2011 which supported the backcrossing of virus resistance into the Peruano background. The backcross portion of the breeding process required four generations, followed by additional generations to stabilize the resistance. Using greenhouse and field, three generations per year were possible. Crossing was initiated during the fall of 2009, and BC₃F₃ families had been obtained by fall of 2011. The resistance was then stabilized so that the breeding lines breed true henceforth. Then researchers validated resistance by screening directly with the virus challenge. Finally lines were advanced to homozygosity by selfing for an additional three generations. In this granting period (2013-2015), the top performing lines were evaluated in trials in the U.S. and Mexico for yield and quality trials to identify the best line for release.

Project Approach

When this project began, we had about 50 lines that were genetically fixed and had yellow seed color combined with virus resistance. These were narrowed to four lines using a combination of verification of virus resistance, selection for early maturity in the field, and selection based on the best seed type. These advanced lines were placed into trials in Oregon and efforts were initiated to increase seed for larger scale testing. Seed was sent to a winter nursery in Indio CA for increase, then to Idaho for additional increase by the University of Idaho Foundation Seed Program. Some of this seed was used to enter the advanced lines into the National Cooperative Dry Bean Nursery where it was trialed at about a dozen locations in the major bean growing areas around the U.S. Based on these trials, the number of advanced lines were narrowed to two and seed was sent to Sinaloa for large scale trials. Based on the data obtained from all trials, one dry bean line was selected for release under the name 'Patron'. Certified seed may be available beginning in 2017.

Members of the Idaho Dry Bean Commission also shared trial results and promoted Idaho Certified Seed at the Agro-Expo Sinaloa.

Goals and Outcomes Achieved

The main goal of this project was to develop a niche market for Idaho in production of yellow bean seed for the U.S. and Mexico markets. To do this yellow bean cultivars are needed that are adapted to Idaho production systems, with the requirement of having BCMV and BCTV resistance. We developed and released a new Peruano variety with virus resistance that had performed well in many locations in the U.S. and Sinloa Mexico. Additional lines are in the breeding pipeline and may be released in the near future.

Beneficiaries

This project benefits all Idaho and U.S. exporters that increase their seed stocks, and/or that have production facilities in Idaho. There are approximately 30 bean dealers located in Idaho and over 500 bean growers, all of which could benefit directly from the expansion of a new premium market being developed for Idaho produced yellow bean seed.

Lessons Learned

There were approximately 53,000 visitors and 500 exhibitors at the show IBC attended and subsequently reported on.

From IBC collaborator Jim Myers:

We make these comments as the culmination of a project that spanned three Specialty Crop Block Grants (SCBG) over a period of six years. The first four years were spent breeding, selecting and stabilizing bean lines with the desired properties and the last two years were spent on seed increase and testing to finalize selection of lines for release of cultivars. We learned that it is possible in a relatively short timeframe to use marker assisted selection to breed new dry bean cultivars. A breeding program typically takes a decade or so from cross to finished cultivar, but in this case, we achieved our goals in a significantly shorter timeframe. There is a need for better molecular markers. We used SCAR markers, which are dominant and did not allow us to distinguish heterozygotes from homozygotes during the backcrossing process. Had we been able to do this, the process might have been even more rapid than what we achieved. Access to the new common bean genome sequence could potentially allow us to develop better markers for future selection work for the disease resistance genes of interest. During the course of this project, we learned that preference in Mexico is for larger, more intensely yellow colored seed. The breeding process has a long enough timeframe that stakeholder preferences may shift from start to finish of the project. It is therefore important to closely monitor stakeholder needs as the project proceeds.

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Increase the Exposure of the Idaho Wine Industry

Subrecipient

Idaho Grape Growers and Wine Producers Commission (IWC)

Project Summary

The Idaho Grape Growers and Wine Producers Commission (IWC) set a goal of maximizing the current momentum of Idaho's growing wine industry, in order to evaluate Idaho wine to take it to the next level of awareness through new, longer-lasting marketing avenues. The IWC has seen success with traditional advertising, but wanted to use different marketing tools to diversify its reach. In addition to the traditional advertising, the IWC also used tools such as events, street banners, videos and photography to showcase Idaho wines locally, regionally and nationally.

This project was a building block for the Idaho wine industry as the many elements involved allowed the Idaho Wine Commission (IWC) to reach local, regional and national audiences as part of a progressive movement in gaining exposure of the industry. Between the advertising, collateral of street banners and billboards, and wine event participation, these components allowed the IWC to put Idaho's wine industry and members of the industry in front of a broader audience to not only make them aware of the industry, but to also keep the industry relevant and top of mind as previous efforts had started that process. The IWC is continually working to keep the Idaho wine industry at the forefront of people's minds and previously funded projects laid that ground work, as this project successfully proved to leverage the momentum of the previous projects and gain increased recognition from consumers, trade and media around the country.

Project Approach

There were many components of the grant that involved working with a marketing agency and public relations firm, both of which had been contracted in previous years through the Idaho State request for proposal process. Meetings were set up with Rizen Creative and Red Sky Public Relations to determine a plan of action for upcoming projects and structure the series of steps necessary to complete these projects. These two companies worked well in conjunction with the IWC to create a cohesive image of the industry that appropriately represented the to consumers, journalists and critics.

Two projects the IWC wanted to complete in the fall of 2013 was the creation of an Idaho wine video and new photography to capture the beauty of the region, especially during harvest. In order to have a professionally produced video that would represent the industry appropriately, the IWC worked with Rizen Creative to develop the storyline and produce the short film. It was important to make sure that the video grabbed viewer's attention while portraying an approachable yet sophisticated industry. Upon completion of the video, IWC had a product that the industry was proud of and with the help of Red Sky Public Relations, was able to show it off across the country. It has been used at trade events, on the IWC website, and was also submitted into a highly respectable industry magazine's video competition, Wine Spectator. Unfortunately it did not win, however the IWC has utilized it to market the industry and has been nationally recognized. To showcase the video in Boise, it ran for 4 weeks at Boise Classic Movies prior to the feature film.

While the video was being developed, the IWC set a schedule for print and digital advertisements that would utilize the new photography captured by Ray Gadd. In order to save money, all ads were edited

in-house to accommodate the new photography, the results were well received. The new photography was also used to update the remaining freeway billboard along I-84 which ran from December 2013-November 2014. This billboard was used to market the region in Southwestern Idaho where most of the wineries are located and the grapes are grown. The billboard came in under budget due to negotiations by the IWC.

Setting the schedule for print and digital advertisements took place ahead of schedule, in early November 2013 in order to capitalize on discounts and negotiate for lowered rates. Many of the advertisements were scheduled to run in early 2014, through June, which is Idaho Wine Month, and into the fall. Advertisements covered a broad range of events and marketing objectives including UnWined at the Movies, Savor Idaho, Idaho Wine Month, Thanksgiving Weekend and Sippin' in the City in addition to general Idaho wine industry ads. Both grant funded and matching funded ads were placed with *Treasure Magazine/Idaho Statesman* (46,521 Circulation), *Wine Press Northwest* (14,000 Circulation), *Cumulus Radio* (131,400 Weekly Listeners), *The Spokesman Review* (65,074 Circulation), *GreatNorthwestWine.com* (13,100 Monthly Visitors), *SIP Northwest Magazine* (50,000 Circulation), *Business Insider* (46,521 Circulation) and Facebook. Matching funds also attributed to advertisements in the *Idaho Business Review* (3,500 Circulation), *Boise Weekly* (35,000 Circulation). The original specialty crop grant application had listed advertising with *Edible Idaho South* and *Northwest Travel Magazine*, however rates for both of these publications had changed and greatly exceeded the proposed budget. In order to maximize dollars and exposure, it was determined to use the funds for outlet signage, media boxes, events and conferences. The IWC felt that this was a more useful shift in funds.

With the assistance of Watershed Communications, the IWC targeted 30 journalists to educate on Idaho's growing wine industry by sending the Idaho's Best Case Scenario. Included in the best case are selections from wineries, collateral informing the journalist on what Idaho has to offer, how much the industry has grown over the years in terms of new wineries, number of acres planted and the significant embracement of this "new" wine region the IWC has seen from consumer's.

Funds that were left from the freeway billboard and wine video were used to supplement a second photography session in Northern Idaho in October 2014 in order to capture the beauty of the area as well as its growth. With the extra funds the IWC was also able to begin a second, professional produced wine video. This video was created to compliment the first and was completed in November 2014.

During the entire month of June, 110 Idaho Wine Month banners were hung throughout downtown Boise to bring attention to the wineries and their events. June was proclaimed Idaho Wine Month by Governor Otter in 2009 and these banners assisted in highlighting wineries in the state. The banners were hung middle of May, at no additional charge, because the IWC has established a great working relationship with the Downtown Boise Association, and there were no other banners scheduled for this time period. Banners were located on main streets in Boise including Front Street and 9th Street. The Idaho Wine Month street banners were designed in 2013 and were printed and hung with the help of the Downtown Boise Association. There is a one-time expense associated with printing of the banners so

for future years the expense will only be the annual placement of banners and any printing of new or replacement banners.

At the time the grant was awarded, the application included three events the IWC would to showcase the Idaho wine industry. The IWC identified these events as being appropriate for exposure of this specialty crop as well as areas where visitors were shown to have traveled to Idaho. On February 23rd, the IWC attended the Seattle Wine and Food Experience to pour Idaho wine for a crowd of 2,000 media and consumers in attendance. The IWC poured 15 different Idaho wines representing the entire state. To have greater exposure and stretch the funds, the IWC worked with the Division of Tourism and Southwest Idaho Tourism Association (SWITA). With funds from the grant, the IWC was able to procure a marketing package with Salt Lake Magazine that not only allowed IWC to place a full page advertisement in their magazine, (a \$8,500 value), but also include the booth registration and event participation into that package. For the price of the ad, the IWC was able to attend TasteMakers in Salt Lake City, UT on May 29-30 and represent the industry as well as pour wine from 8 Idaho wineries to a crowd of 1,500 general admission attendees and 250 VIP attendees. Due to alcohol laws in Utah, it is very difficult to get outside producers featured at events, however the IWC was able to work with the state's Alcohol and Beverage Control office allowing eight different Idaho wines to be poured during the two-day event. The IWC partnered with the Division of Tourism as well as SWITA once again to help cover the additional expenses for the package while the IWC covered expenses for travel and to have members available with their product to represent the industry. This two-day event provided a well-received platform for Idaho winemakers and representatives to share their stories. Feedback from those who attended was very positive and there have been groups of consumers traveling from Salt Lake City to visit Idaho tasting rooms as a result of this event.

Originally the IWC had planned on participating in Vintage Spokane, however the organizers of the event decided to forego holding an event in 2014. Due to this change, the IWC chose to take advantage of an event in Seattle, Around the World in 80 Sips where nearly 300 consumers attended to taste wines. This was a unique event that allowed for Idaho wines to be tasted next to various wines from around the world, favoring well with the consumers in attendance. Seattle is one location among thirteen throughout the country where Around the World in 80 Sips is held with great success.

The IWC had planned on participating in the Sun Valley Wine Auction as well as the Festival at Sandpoint, however Idaho wineries have chosen to attend these events to represent themselves. Since the wineries are choosing to attend these events themselves, it was deemed unnecessary for the IWC. This shows a positive shift for the IWC and allows IWC to focus on representing the industry at new events. Since the IWC did not attend the Sun Valley Wine Auction or the Festival at Sandpoint, IWC was able to attend *Sunset Magazine's* Celebration Weekend where over 3,000 wine oriented consumers attended each of the two days, in addition to WineAmerica, the Wine Blogger's Conference, LIVE Conference and a media trip to New York with the Boise Convention and Visitors Bureau. Each of these events was an exceptional opportunity for the IWC to promote Idaho wines to diverse groups of individuals. WineAmerica's spring conference has about 40 participants from different wine regions around the country and also provides the Idaho Wine Commission with an opportunity to meet with

Senator's and Congressmen while in our Nation's Capitol. WineAmerica's fall conference has about 30 participants from different wine regions around the country. The Wine Blogger's Conference hosts around 300 participants and the LIVE Conference hosts around 170.

On September 16th, the IWC hosted a restaurant educational boot camp for the second time. Thirty-one restaurant representatives across the state of Idaho traveled to the Treasure Valley to become educated on the industry as a whole as well as the wines served in their establishments. Attendees were taken out to wine country to show them where the product comes. There was very positive feedback from the tour. The IWC has determined this will be an on-going tour that will be used to educate not only restaurant personnel, but wine retail shops, hotels and media. This was a collaborative effort with Idaho Preferred to feature local wines and local food. This emphasizes how easy it can be to support both industries by carrying the products in their establishments.

Goals and Outcomes Achieved

The following are some of the goals achieved by this project:

- Increase in Idaho wine sales within the state
- Increase in website traffic
- Increase media exposure
- Increase in social media traffic

As a Commission, the IWC had set certain goals to measure the effectiveness of its projects and programs. These same goals were used to measure the growth of the industry through projects supported by the specialty crop grant.

Every quarter, the Tax Commission collects reports from each winery for their taxes paid based on sales by Idaho wineries to individuals in their tasting rooms, retail outlets, distributors in-state and distributors out of state. The IWC uses these numbers to calculate the changing market share within the state. The market share is based on how much Idaho wine is sold within the state through individual tasting rooms, retail shops and distributors versus how much total wine is sold within the state from out of state producers. This number does not account for any Idaho wine sold outside of the state of Idaho. The market share goal was to increase the number of gallons of wine sold from 127,636 to 135,000 in 2014. By the end of 2013, 178,730 gallons of Idaho wine was sold in the state. For the first two quarters of 2014, 153,967 gallons of Idaho wine was sold within the state. By the end of 2014, a total of 301,352 gallons of Idaho wine had been sold in Idaho in comparison to the 1,821,855 gallons of total wine that was sold. This gave the industry a 6.69% market share for 2014, up from 5.86% at the end of 2013!

Early on, the IWC surpassed its goals for social media numbers set into the year 2015. Originally, the goal was to hit 1,500 fans on Facebook by the end of 2015 and 2,500 Twitter followers. Both of these goals were passed in early 2014 and continue to grow steadily. At the end of 2014, there were 3,009

Facebook fans and 3,971 Twitter followers. Both of these numbers more than doubled within the 2014 calendar year.

The IWC website is one of the most valuable tools for communicating information. It allows IWC to have resources available to consumers, journalists and the media. The goal for the website was to reach an average of 6,000 visitors per month in 2014. The year ended with an average of 6,765 average monthly visitors, up about 1,500 from 2013, which ended at 5,163. In addition to surpassing our goal before the end of 2014, IWC would also like to note the most visited pages of the website were those of IWC members where additional information about their individual establishments can be found.

The goal of reaching 115,000,000 media hits through articles by the end of 2013 was surpassed with 126,004,966 hits. Unfortunately for 2014, the year ended with 54,726,301. Due to cost saving changes, the tracking of these numbers changed during the year and it is possible that could have caused some discrepancies in the reporting. The IWC is confident that with media exposure in Touring and Tasting Magazine and Sunset Magazine in 2015, the numbers will once again reflect the growth in publicity for the industry.

Beneficiaries

With a purpose of marketing and promoting all wineries and vineyards located within the state of Idaho, the IWC represents 51 licensed wineries over 1,300 acres of vineyards. In February 2014, the IWC commissioned an economic impact study to retrieve valuable information of how the industry is growing. According to the report, completed by Stonebridge Research Group, the Idaho wine industry had a total economic impact of more than \$169 million in 2013, that is nearly \$100 million more than 2008 when an economic impact study was conducted by Boise State University. The industry has not only grown in terms of overall economic impact, but also in the number of wineries established in the state, and the number of cases of wine produced. In 2012 there were 179,127 cases of Idaho wine produced and in 2013 there were 234,769 cases. These numbers of growth are important in showing that the Idaho wine industry is moving forward. As the number of wineries in the state grows along with the number of cases produced it has a direct effect on this specialty crop, as it starts in the vineyard. There is currently a supply and demand condition that causes the need for more vines to be planted in Idaho.

The purpose of this specialty crop grant was to increase the exposure of the Idaho wine industry. IWC believes that by attending and pouring Idaho wine at local, state and regional events, in addition to spreading the message of Idaho wines through advertising, social media, videos and other prominent marketing avenues, IWC has been able to expose more consumers, journalists and regional and national industry members to Idaho wines. The Commission is currently working on wrapping up final expenses to be paid as all projects have been executed. Once the final invoices have been paid, the grant will be concluded.

Lessons Learned

Although there were no delays or problems to interrupt the progress of the projects outlined throughout the proposed timeline, there was the need to shift funds from originally planned projects. The main lesson that was learned was to be adaptable to changes that alter the original plan. Due to increased costs for advertising with previously selected outlets, canceling of events and negotiating for lower rates, those unspent funds were reevaluated and found to be more useful in other areas. This allowed the IWC to be able to revamp its course of action in order to most effectively promote the industry through avenues that were not previously available or were unknown at the time of applying for the specialty crop grant.

Matching funds from the IWC were also modified from the original plan in order to focus more on the education of members and consumers in order to not only promote the industry, but to also raise the quality level of the product. As more members are realizing ways to improve their grape and wine quality and exposure, the IWC is able to help make it possible for them to take advantage of resources available. Education was not only for IWC members and consumers, but also for Idaho legislatures to learn more about this specialty crop industry contributing to their state.

Originally the IWC had planned on having more work done by both Rizen Creative and Red Sky Public Relations, however, since more projects were brought in-house, IWC was able to save money and spend it on education, events and conferences. This practice will be utilized going forward so that the IWC budget can be better distributed among the various projects that further promote this specialty crop that continues to grow in the state of Idaho. While making certain transitions for information to be brought in-house, there were some adjustments made to the way that data was collected and as IWC become more comfortable with the process, these numbers will only continue to become more reliable and consistent.

With the experience gained from managing previous grants, the IWC is continually improving our reporting process and learning how to best maximize the opportunities provided to IWC.

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Plant Something Idaho Marketing & Promotion Campaign

Subrecipient

Idaho Nursery & Landscape Association (INLA)

Project Summary

Plant Something Idaho has been of utmost importance to the industry to rebuild after the economic downturn. The timeliness is evidenced by the national wave “green” solutions and shopping locally. INLA received previous funding from a specialty crop grant which allowed INLA to promote the health benefits of getting outside and working in your yard. The previous grant focused on billboard ads and additions to the Planting Idaho website. This marketing campaign allowed INLA to take the Plant Something movement to the next level and expand our consumer accessibility.

Project Approach

INLA’s objective for this project was to increase consumer awareness of the Plant Something grassroots campaign and give them more resources to learn how to care for and where to purchase nursery and greenhouse plant material grown in their own state. Retail garden centers are where most consumers shop for plant material since the logistics to purchase online and receive the material is prohibitive. All of the material that INLA produced including an educational buyers’ guide (magazine), banners and the website lead consumers back to the retail locations where they purchase locally. The components of this project built upon the success of the initial campaign, while working towards the central goal of increasing the competitiveness and long term sustainability of specialty crops in Idaho.

INLA traveled from Idaho Falls/Boise to Spokane Washington and then on to Post Falls Idaho to attend the Turf, Tree & Landscape conference on February 20, 2014. During the event they had an exhibitor booth where they used retractable banners in the display booth and handed out information on changes to the plantingidaho.org website. They also told the attendees (approx. 120) about the upcoming Buy Local Plant Something magazines.

During March of 2014, INLA attended the Boise Flower & Garden Show. Their retractable signs were used again to convey the Plant Something message. INLA handed out buttons, seed packets and over 4,000 Buy Local Plant Something magazines. The show had approximately 10,000 attendees.

Throughout April of 2014, INLA attended about 10 Idaho local city Arbor Day events (with attendance ranging from 10 to 100 in the various locations) and promoted the Plant Something message. At these events there was an Arbor Day celebration with a program and plant a tree event. Plant Something banners and/or signs were displayed at the events. Buttons were given out with the Plant something message.

A pinterest page was built and a link added to the plantingidaho.org website.

INLA had some remaining supply funds due to the lower cost to print the magazine, so in May it ran an ad in the Buy Idaho Directory using artwork from one of our retractable banners. Buy Idaho partnered with the Idaho Press-Tribune so in addition to all Buy Idaho members (distribution of 8,000) the

directory was distributed to: Idaho Press-Tribune with 20,000 distributions; Meridian Press with 15,000 distributions; and Emmett Messenger Index with 5,000 distribution.

INLA distributed copies of the magazine at events in June and July and also through the mail when requested. We have very few of the 6,000 magazines leftover.

In August INLA contracted with Catalyst to do an analysis on the plantingidaho.org website and give us recommendations for improvement. INLA then sent those recommendations over to our website designers.

In September, Spectrum Net Designs performed and update and used the Catalyst recommendations to improve the plantingidaho.org website. Many of the changes made were to the overall appearance of the website. Home link; background changes; boxes for Facebook and Pinterest icons; changes to footer links; addition of image slider; making video's more visible; intro's for some of the pages; widen columns and make the services page easier to read and city names stand out more. Besides just enhancing the overall look of the website we believe that these changes will make a difference on how many hits we get plus the click throughs will increase. We may not see the changes in our website counters until people start looking for information late in the fall or early next spring.

Specific activities completed during the grant period are the following:

- Created text for website, FAQ's, resource guide, tips for gardener's
- Hired graphic artist to add INLA logo and text to display banners
- Printed Plant Something Idaho display banners
- Facebook page text and graphics
- Content and Layout of Buy Local Plant Something Idaho buyers guide
- Printed Buy Local Plant Something Idaho buyers guide
- Had website, Facebook, and Pinterest, display banners ready to launch and share with 2014 Horticulture Show attendees
- Created before and after survey for consumer flower & garden and home shows
- Informational and educational information posted to Facebook as needed
- Informational and educational Information posted to Pinterest as needed
- Home Shows, Flower & Garden Shows, school presentations, Arbor Day events throughout the state of Idaho
- Monthly data point collected from website and Facebook

Goals and Outcomes Achieved

To increase consumer awareness of "Don't Just Stand There- Plant Something" INLA opted to include several communication tools including the website, social media and printed material. One of the goals was to embed YouTube videos on the website as an opportunity to learn more about gardening. INLA has included one on pruning techniques, specifics for growing specialty plants, sustainability in urban areas and a look around the state at botanical gardens and the display gardens they have that feature things you can do in your own backyard. The Boise Urban Garden school video features children talking

about the enjoyment they receive out of working in the garden. Another goal with the website was to create a mobile friendly version that would appeal more to the under 40 consumer. A Facebook link to the national Plant Something site was embedded. This site has weekly garden tips. INLA created a Pinterest page that encourages appropriate and timely discussions and articles of interest.

Specifically, the following expected measurable outcomes were completed:

Goal #1 – Website and Social Media

- Expanded consumer accessibility, especially to people under 40, for the *Plant Something Idaho* website. Created resource area and timely tips for the gardeners. Frequently asked questions page to help consumers make the right choice for plant material based on their geographic location in Idaho. The current website is static; the expansion of the website allowed it to represent the growing seasons in Idaho. YouTube videos were embedded on the website as another opportunity to learn about the *Plant Something Idaho* campaign. In April 2014, Spectrum Net Design did the website work to make the site more accessible. They added several links and articles, updated the “about us and favorite” page so people could access information on where they could find products/services, embedded how-to videos, added a career link and a link to the Buy Local Plant Something magazine.
- Facebook and Pinterest had links back to appropriate and timely discussions and articles of interest. The national Plant Something campaign had developed a Facebook page so INLA was able to direct consumers from the plantingidaho.org site to that Facebook page, which saved time and money. In May 2014, INLA built the Planting Idaho Pinterest page.
- Number of visits to the updated website and areas of greatest consumer interest. Number of Facebook friends and Pinterest shares.. An online survey requesting zip code, age, household income and education was offered to visitors on website and Facebook.
- Targeted increase internet consumer interaction with industry members through website, Facebook and Pinterest traffic by 50%.
- Data Collection Plan Google Analytics data for the website gathered and plotted for each month before and after website upgrade. Data points will include: visits to the website, length of stay on site, email sign-ups, links to industry members.
- Data Collection Plan Records were kept for the duration of the grant project period. Data points included: number of Facebook friends and likes, comments and Facebook and Pinterest shares. However, accessing these data has proven to be difficult. At this time, INLA is working on getting this information from Spectrum Net Design and will report on the target objective as soon as the information is available.

Goal #2 – Consumer Awareness

- Increased consumer awareness through the *Plant Something Idaho* campaign. Purchased consumer driven promotional banners for display at consumer shows and special events. The Arizona Nursery Association (ANA) has incurred the initial cost of graphic design, reducing the implementation expense for Idaho. Updating the Buy Local Plant Something Idaho educational buyer’s guide.
- Number of consumers exposed to the campaign throughout the state increased to over 35,000 consumers
- In March 2013, 10,000 consumers were exposed to the campaign at the Boise Flower & Garden Show. Statewide Arbor Day celebrations displaying banners and disseminating educational buyer’s guide. Additional promotional events were held in 2014.
- Surveyed attendees of events asking if this is their first exposure to the campaign or have they seen previous years marketing materials.

Beneficiaries

Internally the INLA members had access to material and website links so that they could include it on their website and in marketing efforts. The educational buyer’s guide (magazine) encouraged the purchase of plant material from industry members. Externally some of our members produced the

“how-to” videos and presented them in their stores, at home shows and state fairs. Our collaborations with industry associates such as the university of Idaho Extension Educators, Idaho Department of Lands and botanical gardens throughout Idaho also helped convey the message to consumers.

Additional groups that were benefited from this grant include greenhouse growers, tree growers, turf growers, retail nurseries, landscape contractors, nurseries and growers of indoor and outdoor vegetables, herb plants, perennial and annual flowers.

The project benefited the entire Idaho nursery crop industry. This industry, according to a University of Idaho survey, has total sales of \$834 million. Educating users of the environmental benefits of planting with the Plant Something campaign will result in cities and neighborhoods with sustainable, mature landscapes with higher carbon sequestration capabilities and therefore all Idaho residents could benefit from the results of this project. The impact of this grant will reach far beyond the 1,100 companies who hold nursery licenses in Idaho (which include growers, retail garden centers and landscape contractors). Because the target meets a need of each level of the industry and the general public an actual total number cannot be quantified.

Additionally, since there is now a nationwide benefit to this project with the enlistment of several other states, the impact of this nationally, cannot be quantified, however it is significant as it continues to grow.

Lessons Learned

The major lesson learned is that there is more time involved in maintaining the website and Pinterest page than was originally thought. To keep the website fresh requires regular visits and knowing what needs to be changed out. Thankfully the Facebook page is done by the national Plant Something administrator and she is very good at keeping up to date information. With the help of volunteers our Pinterest page stays fresh. It was very encouraging that in 2014, 668 people saw pins from Planting Idaho on Pinterest.

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Monitoring Potato Psyllid Biotypes in Idaho

Subrecipient

Idaho Potato Commission (IPC)

Project Summary

Zebra chip (ZC) is a serious, emerging disease of potato that has resulted in multi-million dollar losses annually since about 2000. Found in the Pacific Northwest (PNW) during 2011 and 2012, ZC is caused by the bacterium *Candidatus Liberibacter solanacearum* (Lso) which is transmitted by the potato psyllid (*Bactericera cockerelli*). Infected potato produces tubers with striped necrotic patterns that become dark when fried, making chips and fries unmarketable. Three different geographically based psyllid biotypes have been identified in Idaho between 2013 and 2016, carrying two different haplotypes of Lso. We characterized the seasonal phenology of different Lso-carrying psyllid biotypes both during and beyond the growing season and developed and implemented tools for biotyping psyllids in Idaho. This filled a critical gap in our understanding of the ZC disease epidemiology in Idaho

Project Approach

The following activities were conducted:

1. *Developed and validated probes and protocols for Lso typing, and also for potato psyllid haplotyping.*

To haplotype the Lso bacteria, a Cleaved Amplified Polymorphic Sequences (CAPS) marker was developed and used to discriminate A and B haplotypes of Lso (Dahan et al., submitted). We also developed our in-house haplotyping tools for distinguishing psyllids, based on high-resolution melting curves, according to the methodology originally published by Kylie Swisher and James Crosslin (USDA-ARS, Prosser, WA). Over 3,200 psyllids were analyzed for the presence of Lso, and Lso-positive samples were subjected to Lso typing (Table 1).

Table 1. Summary of the study conducted on psyllids collected in Southern Idaho, with total number collected, number of Lso-positives, abundance of psyllid haplotypes, and Lso haplotypes for each year from 2012 to 2015 (from Dahan et al., submitted).

	Total	Psyllids haplotyped	Lso-positive psyllids	Lso haplotyped	Lso haplotypes		
					A	B	Mixed A/B
2012	1150	559	304 (26.4%)	224	224	0	0
2013	1085	369	29 (2.7%)	15	13	2	0
2014	170	164	4 (2.4%)	3	2	1	0
2015	1148	365	41 (3.6%)	27	4	21	2

2. *Characterized off-season distribution and abundance of potato psyllids in agricultural fields and in putative overwintering sites with alternative hosts*

Psyllids are native to North America, and four haplotypes have been identified and named based on their predominant geographic association: Northwestern, Central, Western and Southwestern. Although all psyllid haplotypes have been found in Southern Idaho potato fields, data on relative haplotype abundances and dynamic changes in the fields over time have not previously been reported. Here, psyllid samples collected in Idaho potato fields from 2012 to 2015 were used to clarify spatial and temporal patterns in distribution and abundance of psyllid and Lso haplotypes. A shift from hapA toward hapB population of Lso was revealed during these four seasons (Table 1), indicating possible evolution of Lso in Idaho fields. Although we confirmed that Western psyllids were the most abundant by far during the four seasons of observation, we also observed changes in abundance of other haplotypes, including increased diversity of psyllid haplotypes during 2015 (Fig.1). Seasonal changes observed for the Northwestern and Central haplotypes could potentially be linked to psyllid migration and/or habitat changes. South-central Idaho exhibited more diversity in psyllid haplotypes than Southwestern Idaho.

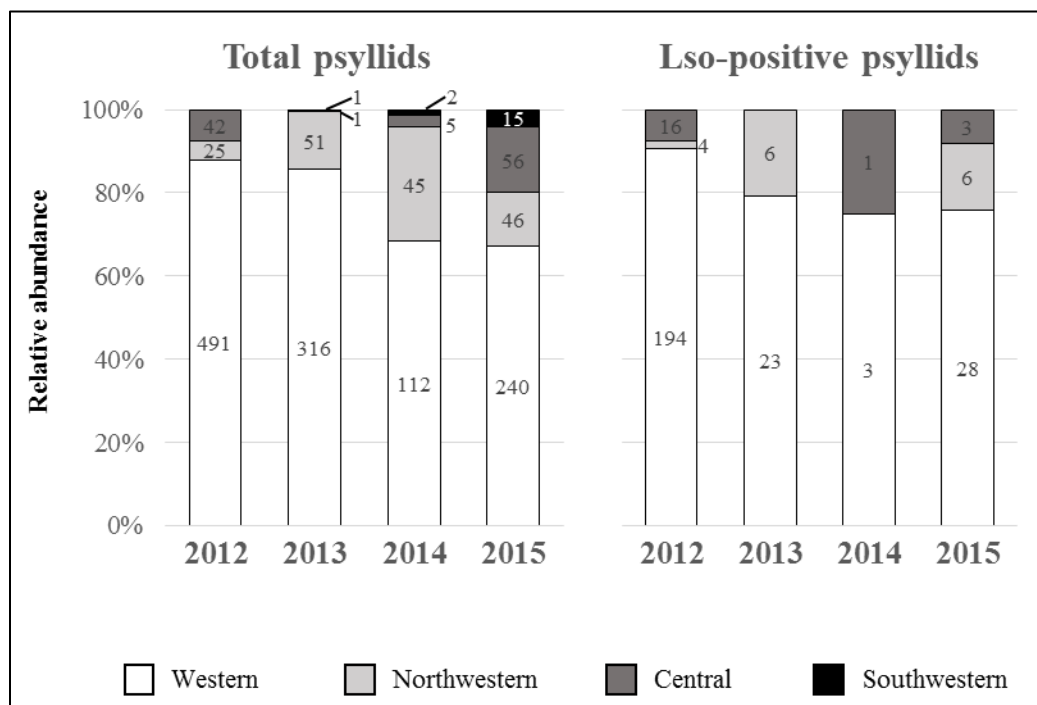


Fig. 1. Analysis of the population of haplotyped psyllids during the potato growing seasons of 2012 to 2015. A subset of Lso-negative psyllids and all the Lso-positive psyllids, for each considered year, were subjected to HRM analysis for haplotyping. The relative abundance of each haplotype is reported for each year. For Lso-positive psyllids, actual numbers of psyllids for each haplotype is reported. From Dahan et al., submitted.

3. Comparison of psyllid haplotype diversity in Treasure and Magic Valleys.

The Snake River Basin in Southern Idaho can be divided into at least two large areas, based in part on population centers and on different agricultural practices: the Magic Valley and the Treasure Valley. These two regions exhibited a different composition of psyllids, with some changes over the years (Fig. 2). Western psyllids comprised most of the psyllid population in the Treasure Valley, with a relative abundance of ~92% in 2013 and close to 80% in 2014 and 2015. Northwestern and Central psyllids represented the remaining parts, with the Southwestern psyllids being marginal in that area.

While the Northwestern population remained quite stable from 2013 to 2015, the relative abundance of Central psyllids steadily increased, representing 0.436%, 4.2% and 12.8% in 2013, 2014 and 2015, respectively.

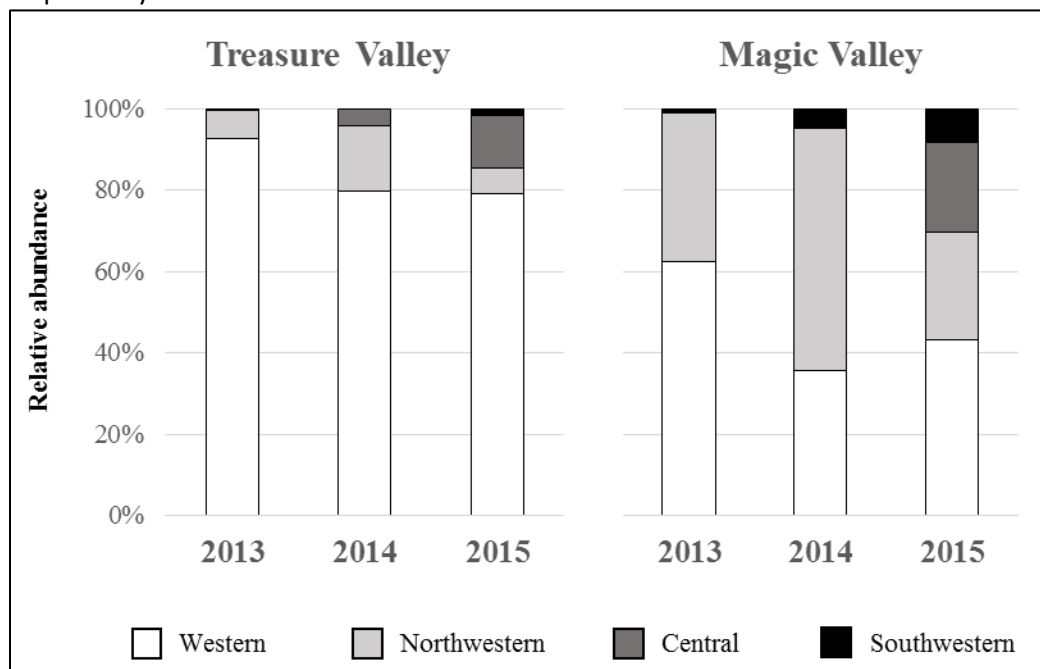


Fig. 2. Relative abundance of potato psyllid haplotypes separated by geographic region. The relative abundance of each psyllid haplotypes, obtained by HRM analysis, was analyzed based on the area each psyllid was collected. The areas considered were the Magic Valley and the Treasure Valley. From Dahan et al., submitted.

In the Magic Valley, the psyllid population was found to be more mixed. The population was mostly composed of Western and Northwestern haplotypes in 2013 and 2014. Western psyllid abundance was 62.5% and 35.7% in those years, respectively, while Northwestern psyllid abundance was 36.5% and 59.5% in the same years, respectively. Relative abundance of Southwestern psyllids showed a slight increase over time in the Magic Valley, from 0.9% in 2013 to 8.5% in 2015. In 2015, Northwestern psyllid abundance decreased to 26.2% and Western psyllid abundance remained stable at 43.2%. A sudden rise in the Central haplotype, absent in 2013 and 2014, was observed in 2015, reaching 22%. The Magic Valley appeared to have a very mixed population of psyllid haplotypes in 2015, as compared to the Treasure Valley, with all four haplotypes represented, while Western psyllid haplotype remained the dominant one in the Treasure Valley.

Goals and Outcomes Achieved

- Psyllid and Lso haplotyping were conducted on psyllid samples collected in Southern Idaho between June 2012 and October 2015. A large archive of Lso-positive and negative psyllids was created for subsequent molecular genetic studies. The total number of psyllids tested for Lso exceeded 3,500, with 378 found Lso-positive.

- A novel, CAPS based marker was developed for fast typing of Lso samples. This was validated on a large number of Lso-positive samples. A shift in Lso population from A-type to predominantly B-type was documented between 2012 and 2015.
- The composition of psyllid haplotypes was determined for each season between 2012 and 2015, this composition changed over the course of each season, and was more diverse in Magic Valley area over the Treasure Valley of Idaho.
- The biotyping and haplotyping data collected during this project provided a necessary foundation for the study of the epidemiology of ZC disease in Idaho potato.
- Present research results and hold zebra chip workshop at Idaho potato conference:

Wenninger, E.J., N. Olsen, J. Woodhall, K. Kinzer, J. Miller, J. Dahan, and A. Karasev "Update on potato psyllids and zebra chip" Idaho Potato Conference, Pocatello, ID, January 2017.

Wenninger, E.J., N. Olsen, M. Thornton, P. Nolte, J. Miller, and A. Karasev "Update on potato psyllids and zebra chip" Idaho Potato Conference, Pocatello, ID, January 2016.

Wenninger, E.J. "Using the PNW pest alert system for disseminating weekly updates on potato psyllid monitoring." Idaho Potato Conference, Pocatello, ID, January 2016.

Wenninger, E.J., N. Olsen, M. Thornton, P. Nolte, J. Miller, and A. Karasev. "Three years of monitoring potato psyllids and zebra chip in Idaho." Idaho Potato Conference, Pocatello, ID, January 2015.

Wenninger, E.J., N. Olsen, M. Thornton, P. Nolte, J. Miller, and A. Karasev. "Potato psyllid and zebra chip update." Idaho Potato Conference, Pocatello, ID, January 2014.

Wenninger, E.J., N. Olsen, M. Thornton, P. Nolte, J. Miller, and A. Karasev. "Potato Psyllids & Zebra Chip: 2012 Update." Idaho Potato Conference, Pocatello, ID, January 2013.

In addition, 20+ presentation were developed and presented to various stakeholder groups, industry partners and growers on the subject of zebra chip during this period of time. We also held two zebra chip advisory committee meetings with approximately 30-40 industry personnel and growers.

* Challenges associated with the ongoing renovation of our university websites greatly limited the degree to which we were able to disseminate information through our site and to monitor traffic. However, we disseminated weekly updates of the monitoring program throughout the season using the PNW Pest Alert system (www.pnwpestalet.net), which currently has 1,460 subscribers to all crop alerts and 459 subscribers to potato alerts. In addition, our alerts were reposted to the Idaho Potato Pulse network and other outreach venues that connect to the PNW potato industry.

As part of an evaluation of potato growers who use the PNW Pest Alert system, we asked on a survey whether zebra chip is an important consideration in their operation. In regard to the 2013, 2014, 2015, and 2016 seasons, the percentage of respondents who answered "yes" to this question each year was 84, 85, 90, and 92%, respectively. The total number of respondents was 19, 20, 31, and 26, each year respectively. We further asked respondents to describe how the monitoring program was useful and how it could be improved. Nearly all responses were positive and described how our alerts helped growers to make better decisions on the need to apply insecticides. Several respondents expressed a desire to shorten the process of delivering Lso results. In addition to the PNW Pest Alert survey, we asked attendees at the annual Storage

Management Advisory Committee meeting whether they thought the potato psyllid / Lso monitoring program should continue the following year. During 2013, 2015, and 2016, the percentage of respondents who answered “yes” to this question each year was 88, 90, and 93. The total number of respondents was 43, 40, and 43, each year respectively.

Beneficiaries

Beneficiaries are expected to be all Idaho potato growers, and entire potato industry in the state. Ultimately, consumers will benefit through more affordable prices and better quality of fresh market potato. Understanding of the ZC epidemiology and circulation of psyllids and Lso in the state will help in management of the disease and minimize the use of pesticides in the state.

Roughly 85-90% of potato growers consistently view zebra chip as an important consideration in their operation, and roughly 90% of stakeholders consider the monitoring program to be an effort that is useful enough to be worth continuing.

The estimated increase in production costs associated with additional insecticide sprays for potato psyllids was \$125-175, \$85-125, and \$35-85 per acre for southwestern, south-central, and eastern Idaho, respectively (P. Patterson, University of Idaho, personal communication). Insecticide sprays targeting potato psyllids have remained at a similarly elevated level in more recent years (Patterson 2015).

Lessons Learned

- The haplotypes of Lso circulating in Idaho potato change year-to-year. Between 2012 and 2015 the A haplotype of Lso was partially displaced by the B haplotype.
- The dominant Western psyllid haplotype decreased in abundance during the same period, while Central and Southwestern haplotypes gained ground in Idaho.
- Relative abundance of the psyllid haplotypes in Idaho changes due to geographic location.

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Additional Information

Peer-reviewed scientific publications:

1. Swisher, K.D., Sengoda, V.G., Dixon, J., Munyaneza, J.E., Murphy, A.F., Rondon, S.I., Thompson, B., Karasev, A.V., Wenninger, E.J., Olsen, N., and Crosslin, J.M. (2014) Assessing potato psyllid haplotypes in potato crops in the Pacific Northwestern United States. *American Journal of Potato Research* **91**: 485-491.
2. Dahan, J., Wenninger, E., Thompson, B., Eid, S., Olsen, N., and Karasev, A.V. (2016) Relative abundance of psyllid haplotypes in potato fields in Southern Idaho between 2012 and 2015, and occurrence of ‘*Candidatus Liberibacter solanacearum*’ (Lso) causing Zebra chip disease. *Submitted*.

Promoting Specialty Crops through Advertising and Retail Marketing

Subrecipient

Idaho Preferred

Project Summary

Idaho Preferred® is a program managed by the Market Development Division of the Idaho State Department of Agriculture (ISDA) to identify and promote Idaho food and agriculture products. The Idaho Preferred® program conducts television and radio advertising, retail and foodservice promotions, public relations activities, consumer events and educational programs to increase consumer awareness and demand for locally grown and produced products.

As a result of successful promotions conducted on behalf of specialty crop growers, the Idaho Preferred® program attained brand awareness of 50% of consumers statewide and 51% of consumers reported seeing specialty crops, including fruits, vegetables, wine and nursery products in advertising and promotion materials according to research conducted by the University of Idaho in October, 2012. Additionally, the number of consumers reporting having seen Idaho Preferred® signage at retail location more than doubled from 19% in 2008 to 40% in 2012. This level of awareness was due to the combination of an effective advertising campaign and successful retail promotion strategies.

The goal of the 2013 Specialty Crop Block Grant was to continue this productive campaign through advertising and demand-building promotions carried out by staff. Specifically, this grant supported three weeks of television and five weeks of online advertising to supplement the previously funded campaign, allowing for six weeks of advertising in 2014 and three weeks of advertising in 2015 to help maintain consumer awareness. The grant also allowed for the extension of a Specialty Crop grant-funded staff person to carry out retail and foodservice programs as well as consumer and education events designed to increase consumer demand for Idaho specialty crops through 2015.

Project Approach

Per the work plan, three weeks of specialty crop television ads were placed in Boise, Idaho Falls and Twin Falls markets during September 2014. These three weeks were supplemented with an additional two weeks of television for a total of five weeks of specialty crop television ads placed during the height of harvest season. TV ads feature images of sweet corn, cherries, onions, green beans, dry beans, pears, apples, potatoes and summer squash. The 2014 five-week campaign reached 91% of the target audience an average of 13 times. In August 2015, an additional three weeks of television advertising was placed statewide. These new 15-second “Farm to Fork Bites” feature images of summer squash, sweet corn, tomatoes, peaches, watermelon and apples. The 2015 campaign achieved average statewide reach of 91.3% and 13.6 frequency.

In addition to television, the 2014 specialty crop advertising campaign included five weeks of Facebook advertising in August and September. Facebook ads focused on peaches, sweet corn, green beans, apples, pears, onions, grapes, potatoes and pluots. The Facebook campaign delivered 469,337 impressions and 5,743 click-throughs to the Idaho Preferred website at a cost of \$2,539 or 44 cents per

click. The 2015 campaign also included Facebook advertising. In May 2015 two weeks of Facebook and Google AdWords as well as one idahostatesman.com native ad promoted Idaho's nursery industry products. Four weeks of FB ads in August featured tomatoes, corn, squash and watermelon.

The social media campaign also included Google AdWords. Google AdWords ran nine weeks, July through September 2014. Specialty crops called out in this campaign included summer squash, snap beans, corn, cucumbers, melons, nectarines, peaches, peppers, carrots, onions, tomatoes, winter squash, beets, tomatoes, raspberries, apples, pears, grapes, plums and pluots. The 2014 Google AdWords campaign delivered 112,297 impressions and 3,437 click throughs to the Idaho Preferred website at a cost of \$2,373 or 62 cents per click. A similar nine-week Google AdWords campaign took place in August-September 2015 featuring corn, zucchini, peaches, tomatoes, summer squash, beets, cucumbers, peppers, apples, green beans, winter squash, onions, pears, carrots, grapes, nectarines, potatoes, plums, pumpkin, watermelon, cantaloupe, zucchini and berries.

The final component of the 2014 specialty crop media campaign was homepage slider ads on KTVB.Com – the Boise market's top-rated television news website. The ads appeared on three days: August 29, September 12 and September 26. Home page slider content included peaches, sweet corn, green beans, apples, pears, onions, grapes, potatoes and pluots. On these days, ads were exclusive and in total delivered 221,847 impressions or an average of 73,949 per day for a total cost of \$3,360 or \$0.015 per impression.

In 2015, slider ads were replaced by a series of "native ads" at KTVB.com. These ads featured approximately 500 words of copy including quotes from producers, retailers, chefs and Idaho Preferred staff as well as multiple photos and/or video. A series of six monthly native ads were placed between April and September focusing on asparagus, nursery items, cherries, peaches, melons and corn. Each ad ran until 100,000 impressions were reached for a total campaign reach of over 600,000 impressions.

In addition to media, the fall campaign to promote specialty crops in Idaho included extensive retail promotions with local and national grocery chains. The grant-funded signage identified specific Idaho wines sold at retail in 21 Walmart stores in Idaho in 2014. In addition, signs were created that identified specific growers of specialty crops that were sold in Walmart stores including potatoes, apples, peaches, pears, pumpkins, tomatoes, honey and sweet corn. In Paul's Markets, a local store chain with seven locations, in-store sampling of local fruits including plums, pears, pluots, nectarines and peaches were funded to support August newspaper ads featuring these items. Similar sampling events were conducted in 13 Albertsons stores in September 2014. In 2015, fifty retail bins were produced and distributed as detailed in the grant plan. The cost of these bins was split between Specialty Crop funds and Idaho Preferred funds. With funds remaining in the grant, in-store sampling of fresh peaches were conducted in 19 Albertsons stores in September 2016 in conjunction with retailer-funded newspaper ads and special pricing.

Additional work on this grant includes completion of three chef tours. The first, conducted in July 2014 was attended by 48 foodservice industry professionals and included stops at a tomato farm, winery,

orchard, hop farm and vegetable farm. Evaluations were very positive with overall rating of 4.83 out of 5 and 100% reporting they would participate in another similar tour. Of the 34 respondents, 21 reported that they would buy more local produce and wine as a result of this tour. In October 2014, a second tour was hosted in cooperation with a local brewery that took 14 foodservice and industry professionals on a tour of a hop farm and harvesting facility. The third chef tour in July 2015 included winery, orchard, vegetable and herb farms. No funds from this grant were expended on these events however grant funded staff did organize and conduct the tours.

A USDA Farm to School Conference and Events grant was received in fall of 2014. Grant funded staff helped organize four workshops that were held in 2015 including a producer workshop in February and three workshops for school foodservice personnel held in three different locations across the state. Over 180 producers and school foodservice personnel attended these seminars. Chef demonstrations were included in all of the school foodservice workshops. These demonstrations included use of apples, berries, lentils, beans and garbanzo beans. Farm tours included peach and cherry orchards, an asparagus packing plant, a watermelon farm, two vegetable farms, a dry bean processing facility and a lentil farm. Workshop evaluations included the question: “As a result of this workshop do you plan to serve more local products?” - 97% answered yes.

Goals and Outcomes Achieved

Consumer market research completed in November 2014 was used to evaluate the effectiveness of the Idaho Preferred Specialty Crop promotion campaign and track reported local food buying behaviors. The University of Idaho Social Sciences Center conducted this research. Results compared to target are:

Measure	2012 Baseline	2014 Target	2014 Actual
Awareness	50%	60%	52%*
Buying more local product	27%	40%	30%
Seeing local message at retail	40%	50%	37%
Buying more fruits/vegetables	79%	80%	94%
Buying more nursery	4%	12%	12%
Buying more wine	6%	12%	6%

**State average awareness was 52% but the target awareness goal of 60% was exceeded in southcentral Idaho with 66% and in southwestern Idaho at 63%. Awareness of only 29% in north Idaho negatively affected statewide average. Awareness in north Idaho is very low due to the fact that the area is served by the Spokane television market. We do not place the specialty crop ads in the Spokane market due to the cost in relation to our budget.*

The research found that more consumers are buying more local products, but fell short of the targeted 40%. However, the number of people who report buying more local fruits and vegetables far surpassed the goal of 80% to reach 94%! The target of 12% of consumers reporting buying more local nursery products was met, but there was no increase in reported purchase of local wines. And despite increased retail promotions, fewer people actually reported seeing the local message at grocery stores.

This grant provided funding for staff to conduct promotion and consumer information programs in 2015. Cost of the programs was paid through State funds and previous Specialty Crop grants. The following

measurable outcomes were achieved by the staff funded through this grant. Staff participated in ten different events to increase consumer awareness and provide opportunities to purchase specialty crop items directly from growers and processors. Grant funded staff helped organize four Farm to School workshops in 2015 to help educate foodservice professionals about fruits and vegetables available to schools and how to find, bid and purchase products from producers and distributors. Twelve monthly, seasonal blogs were posted and Facebook posts were made weekly. Nine new specialty crop producers joined Idaho Preferred to take part in demand-building programs. Two new nursery retailers began identifying locally grown plant material in their stores and four new restaurants began identifying local specialty crop items on their menus.

In 2013, USDA conducted a National Farm to School census to measure participation in the Farm to School program. This census also gathered data on use of local Specialty Crops in school meals. Idaho data shows a slight increase in percent of schools participating but decrease in number of schools and students. Reported use of specialty crops, specifically fruits and vegetables, increased by 10% and 11% respectively. There was over 200% increase in the amount of money spent on local products in schools in Idaho from 2013-2015.

Measure	2013 Census	2015 Census
Percent of Schools Participating	44%	45%
Number of Districts participating	51	55
Number of Schools Participating	350	247
Number of Students	107,767	138,671
Dollars spent on local foods	\$1,955,138	\$4,336,710
Percent of schools who plan to increase local products	63%	48%
Percent of schools using local fruits	80%	88%
Percent of schools using local vegetables	72%	82%

Beneficiaries

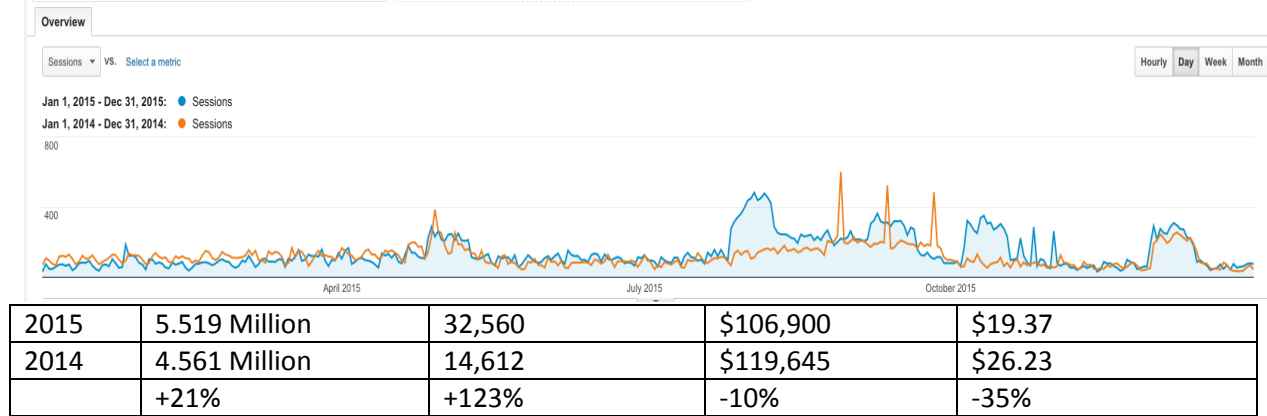
Data from the 2014 Idaho Agriculture Statistics bulletin estimates the value of specialty crops grown in Idaho at over 1.17 billion dollars. This estimate includes cash receipts from potatoes, fruits, vegetables, hops, honey, mint, and nursery crops. All producers engaged in the production of specialty crops in Idaho could potentially benefit from effective television advertising and retail marketing that increase consumers' awareness and intent to purchase Idaho fruits, vegetables, and nursery products.

Idaho Preferred® currently includes 130 producers or processors of specialty crops. All of these members may directly benefit from the advertising campaign, promotions linking growers and processors to retail and foodservice buyers, and from consumer education programs designed to build long term demand and "brand loyalty" for local specialty crop products.

Lessons Learned

Both impressions and clicks were up in 2015 over 2014 despite a lower budget (see table below). This increase in impressions and clicks was due to careful evaluation of strategies in digital media and digital content.

Year	Impressions	Clicks	Budget	Cost per 1000 (CPM)
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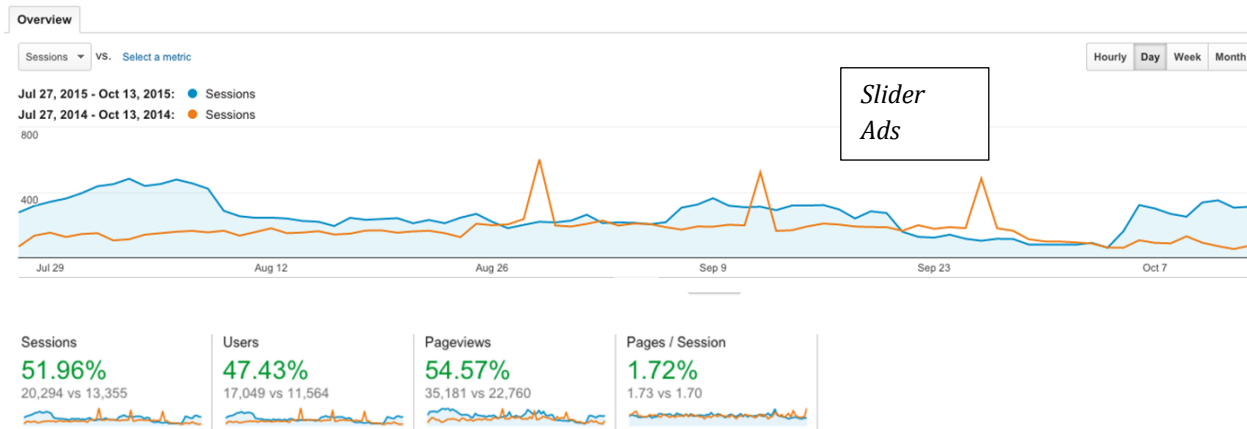


As an example, in 2014, as noted earlier, the specialty crop media campaign included homepage slider ads on KTVB.Com. The ads appeared on three days, August 29, September 12 and 26. The ads did drive traffic to the website as can be seen in the graph below. However, we found the affect was very short-lived, lasting only the day of the ad. This led us to change strategies to replace sliders with “native ads” in 2015.

Website visit up 18% in 2015 over 2014.



The 2015 strategy led to an 18% increase in website visits over 2014 as seen in the graph above. However, as would be expected, results showed that visits to the website are vastly increased by advertising. Visits to the website increased over 50% in July -October 2015 over same period 2014 when television and digital advertising was running that included the website address.



Website visits up over 50% July-October 2015 over same period 2014 when television advertising is airing.

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Sunnyslope Wine Trail

Subrecipient

Sunnyslope Wine Trail Group (SSWT)

Project Summary

Sunny Slope Wine Trail is a single crop organization wanting to conduct an advertising campaign in order to increase visitors and sales for the wineries located in the Sunny Slope community.

Wines made in the Sunny Slope region are mostly made by hand, increasing the cost of production, leaving a smaller profit margin. To use a wine distributor to promote sales in a grocery store or restaurant removes a large portion of the profit margin. In addition, the yearly case production may not be large enough to satisfy demand in a large grocery store chain. The small wineries located in this community mostly rely on their sales generated in the tasting room. The main reason for marketing the Sunnyslope Wine Trail is to increase traffic to the tasting room.

By planning a yearlong calendar of monthly events, the Sunny Slope Wine Trail has provided activities that may appeal to all ages of wine consumers and their families.

Project Approach

With the continuation time for the 2013 Specialty Crop grant originally awarded, the scope of the project defined as followed:

Project Activity	Who	Accomplished
Sunnyslope Wine Trail members re-defined (SSWT)	Hutson Vineyards; Bitner Vineyards ; Fujishin Family Cellars; Hat Ranch Winery; Vale Wine Company; Koenig Winery and Distillery; Hells Canyon/Zhao Zhoo Winery; Ste. Chappelle Winery, Williamson Orchards and Winery; Added Vizcaya Winery, Parma Ridge Winery and SCORIA Vineyards to the Wine Trail	All members of the Trail participate regularly in trail meetings.
Hire Administrative Assistant	SSWT interviewed and hired an administrative assistant work approximately 16 hours a week to manage website, social media, bi-weekly meetings & assist with events	Mallory Walker was hired and fulfilled the expectations of the SSWT
Set Calendar of events	SSWT set year-long calendar of events for 2016	December 2015 confirmed 2016 calendar of events

Supervision of each event at each location	Every member of the trail has participated in a majority of events. Admin Assist oversaw the social media announcements, coordinated winery participation and gathered winery products for event prizes.	Wine & Chocolate, Mardi Gras, St. Pat's Day poker run - March, Buds to Blossoms - April-May, Wine & Art in the Park - May Idaho Wine Month - June SSWT Festival - August Barrel Tasting/Black Friday Christmas in Sunnyslope
Order sign posts		Not completed
Social Media Website:	Facebook & website maintained by Administrative assistant	Social media and Facebook reach were extended due to the

Project Activity	Who	Accomplished
		consistent monitoring by AA See Facebook Stats report attached
Trail map Brochure - print & web based	Administrative Assistant to edit, and prepare brochure for reprint, adding new wineries to the trail	20K printed, distributed across the trail.

Having an administrative assistant, Mallory Walker has been a great help for the Wine Trail. The traffic to the tasting rooms and participation in events has increased the impact of the Wine Trail. Mallory directly supervised the Wine and Art in the Park (May) as well as the SSWT Wine Festival (August).

The May event held in collaboration with the Marsing Chamber of Commerce. As the second year for this event, there was an increase in participation of the wineries from three last year to ten this year. The number of art vendors increased and it was a great event to highlight wine and art supported by the local communities.

The wine festival held in August was a collaborative effort of the SSWT, Destination Caldwell and the Caldwell Chamber of Commerce. The City of Caldwell last year decided to do some rebranding - they have chosen to embrace the Sunnyslope Wine Trail as their theme and destination. The Caldwell actively works with the wineries to promote events and hosts their own farm-to-fork event to highlight SSWT wine. Some additional outcomes include

- 1) Sawtooth Winery is relocating to the Sunnyslope area adjacent to the Ste. Chappelle Winery. This is a move of over 11 miles, to be closer to Ste. Chappelle. It is in their plans to build a new tasting room and 5000 seat amphitheater 2017.
- 2) Ste. Chappelle hosted sold out crowds for their summer concert series. For instance, they turned away over 100 people on Mother's day because they reached facility capacity
- 3) The Koenig Winery, built on to their existing production facility, doubling its size. Koenig also built a new tasting room at the production facility site, increasing the size of the tasting room 10 fold.
- 4) The Williamson Winery purchased a new site and remodeled the existing buildings into a new tasting room/storage facility as well as new office and wine club event space in the adjacent former house.
- 5) Parma Ridge Winery had an exceptional first full season resulting in plans to double the capacity of the tasting room constructed in 2015.

Tasting room staff was increased at Hat Ranch, Bitner Vineyards, Williamson, Koenig, Fujishin and Parma

Ridge. The wineries have increased the days open a week and for the summer months, lengthened the hours.

Goals and Outcomes Achieved

The original goals defined in the grant application were:

1. To increase visitors and generate sales in the respective Tasting Rooms of the nine Wineries collaborating. - though the wineries declined this time around to share their sales amounts, the additional staffing, new tasting rooms and production space would not have happened if sales did not increase.
2. To increase the social media exposure of the Sunny Slope Wine Trail through Facebook page "Destination Sunny Slope" hosted by The Orchard House. SSWT created their own Facebook page and started from zero likes to over 870. Mallory created a tweeter account, she started with two tweets and we now have over 108. Boosted FB posts regarding the Wine Festival reached over 6000 people
3. Recognizing the success that Mallory brought to the SSWT, the wineries each contributed to continue using her services there the end of this year. The SSWT has decided to become an official organization with non-profit status. They hope to accomplish that before the end of 2016.
4. The increase in sales between 2015 & 2016 year end range individually between 5% and as much as 32%. The overall average increase was 17.9% *
 - Data from Parma Ridge was removed from the overages. This is a new winery that only had 4th quarter sales in 2015 versus entire year of sales in 2016. If only 4th quarter sales numbers are compared their increase was over 50%. The following wineries were used:

Indian Creek Winery
Sawtooth Winery
Bitner Vineyards
Zhoo Zhoo/Hells Canyon
Ste. Chappelle

Koenig Distillery and Winery
Fujishin Family Cellars
Hat Ranch/Vale Wine
Williamson Orchards and Vineyards

5.

Beneficiaries

Members of the wine trail are defined as follows:

Hutson Vineyards; Bitner Vineyards; Fujishin Family Cellars; Hat Ranch Winery; Vale Wine Company; Koenig Winery and Distillery; Hells Canyon/Zhoo Zhao Winery; Ste. Chappelle Winery increased participation, Williamson Orchards and Winery; Indian Creek returned, added Vizcaya Winery, Parma Ridge Winery and SCORIA Vineyards to the Wine Trail

Direct benefits:

- 1) Sawtooth Winery is relocating to the Sunnyslope area adjacent to the Ste. Chappelle Winery. This is a move of over 11 miles, to be closer to Ste. Chappelle. It is in their plans to build a new tasting room and 5000 seat amphitheater 2017.
- 2) Ste. Chappelle hosted sold out crowds for their summer concert series. Completed major renovations to tasting room, adding event space upstairs. Increased exposure through the Caldwell Chamber of Commerce as lead winery

- 3) The Koenig Winery, built on to their existing production facility, doubling its size. Koenig also built a new tasting room at the production facility site, increasing the size of the tasting room 10 fold.
- 4) The Williamson Winery purchased a new site located on Sunnyslope Road and remodeled the existing buildings into a new tasting room/storage facility as well as new office and wine club event space in the adjacent former house.
- 5) Parma Ridge Winery had an exceptional first full season resulting in plans to double the capacity of the tasting room recently constructed in 2015. One event lattended this summer there were over 200 people in attendance . This for a tasting room capacity of approx. 30, the overflow covered the patio, lawn and spilled into the vineyard.

Lessons Learned

- Recognizing the success that Mallory brought to the SSWT, the wineries each contributed to continue using her services there the end of this year. The SSWT has decided to become an official organization with non-profit status. They hope to accomplish that before the end of 2016. Growing pains were felt by the wineries in managing the events and increased wine sales. Increase sales caused a need for more staff, which increases the overhead.
- Unexpected outcomes or results that were an effect of implementing this project. The wineries have increased their exposure at Boise Co-op Wine Shop in Boise and Meridian. The wineries regularly pour tastings at the Boise Airport, selling wine out of the gift shop on the departure side. The wineries expressed the intention to increase case production to meet increased needs. Specifically, Bitner, Parma Ridge, Hat Ranch and Williamson ran out of some of their red varietals months before the next year would be released. Bitner released its Merlot in June - even though cases of wine produced nearly doubled in number (from 70 to 120 cases), they are down to their last cases, most likely selling out before Thanksgiving same time as last year. This was a common occurrence. As sales have increased, the wineries have held their financial information private
- I believe the goals were achieved because the members of the wine trail were able to work together. The funding provided through the grant gave them the means to extend the reach of their marketing efforts. The financial assistance for the administrative assistant proved how valuable that person could be to the success of events and keeping track of the trail's paperwork, that is why SSWT is continuing to fund that position.
- Issues did occur related to goals 2 and 3.

- What SSWT discovered was that the 4 B&B's were not functional, i.e. Zhoo Zhoo remodeled and did away with their B&B, one that was under construction never happened and the 2 remaining ones (Bitner & Hat Ranch) were only open seasonally so there was nothing to consistently measure. Hat Ranch closed their B&B early 2016. The B&B was attached to the winemaker's personal residence and it became problematic to have public in and out of the residence.
- The tabulation of visitors and a survey was also problematic in several ways. The majority of the wineries involved did not have base numbers of visitors to start with. Bitner was the only winery tracking visitors in 2013. With small staff to begin with, just supervising the events and handling the increased number of visitors, it became difficult for the wineries to keep up. SSWT did attempt to track wine tasting fees, however only half of the wineries charged tasting fees.
- It became evident that tracking sales was the best way to show an increase in visitors to the tasting room. SSWT showed the increase in "likes" to the Facebook page of Sunnyslope Wine trail and the individual wineries showed a broader presence in social media. The Trail has continued to branch out and utilizes Instagram and to some extent recently added Twitter ~ though they are still learning how to incorporate that into their routine.

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Eradication of the Necrotic Isolates of PVY from Idaho Potato

Subrecipient

University of Idaho (U of I)

Project Summary

Identification and segregation of PVY-positives from the winter grow-out testing

In the past five years, *Potato virus Y* (PVY) has emerged as the most serious threat to Idaho potato production, both directly through yield reduction, and indirectly by affecting tuber quality and rendering tubers unmarketable. PVY now is the main cause for potato seed lot rejections during the seed certification process, seriously affecting the livelihood of potato seed producers in Idaho. The emergence of PVY as a new threat is attributed to the spread of new, recombinant strains of PVY, many of which can cause severe tuber necrosis. These new PVY strains have been tracked down through systematic typing of the PVY strains found during the winter grow-outs conducted by the Idaho Crop Improvement Association. In order to eradicate necrotic PVY strains, we surveyed all seed potato lots rejected based on the winter testing in Idaho, for prevalence of PVY strains with subsequent elimination of lots containing necrotic PVY from the seed potato system. This project continued a previously funded grant (2011-12) which started this systematic typing of PVY strains in Idaho. The prevalence of the PVY^O strain, a non-recombinant, ordinary strain varied from 3 to 14% between 2013 and 2015.

Project Approach

The following activities were conducted:

1. Identification and segregation of PVY-positives from the winter grow-out testing

During 2013, 2014, and 2015 potato seed seasons scrutinized at the state WGO site, we collected over 2,300 leaf samples from Idaho potato seed lots submitted to the winter seed potato grow-out in Waialua, HI. The ELISA analysis was conducted concomitantly with immunocapture-PCR tests. All samples determined to be positive for PVY were subjected to RT-PCR tests for further typing to strain. One sample typed by RT-PCR as N-Wi strain in the 2015 season, was displaying a new serological pattern called “O5”: MAb2-positive, 1F5-positive, SASA-N-negative. This serological pattern was not previously recorded in the U.S. in N-Wi isolates, but was found in a N-Wi isolate of the virus in Brazilian potato. The N-Wi sample with this O5-serology was inoculated into tobacco plants in the greenhouse for confirmation and further study. The O5-serology was confirmed, and the isolate was subjected to the whole genome sequencing to map the 1F5 epitope that binds the commercial N-specific monoclonal antibody marketed by Agdia (Elkhart, IN).

In the first WGO conducted in Hawaii, we observed very clear visual symptoms of mosaic on infected plants, making it easy to identify and collect PVY-positive samples. Due to this improvement, the efficiency of our collection greatly increased, and reached 84% of the all visually mosaic samples (see Table 1). This demonstrated a strong correlation between mosaic symptoms and PVY infection. PVY was apparently the main cause of the mosaic-based rejections of the seed lots. With the new primer set

(Chikh-Ali et al., 2013), we were able to expand the number of PVY strains we could type, which now included N-Wi and NE-11 types, among others (see Table 2). In fact, we realized now that most of the N:O types identified with the Lorenzen set (Lorenzen et al., 2006), are in fact N-Wi types, with actual N:O strain quite rare (below 5%).

2. Type all PVY-positives to strain using our RT-PCR technique.

In 2014, 692 samples were analyzed from the 2013 winter grow-out tests, and the strain breakdown is presented in Table 1. A further drop was noted in the proportion of non-recombinant PVY^O strain relative to other, recombinant strains, both PVY^{NTN} and PVY^{N:O}, comparing to our 2009-10 data. Recombinant strains represented over 90% of all PVY-positive samples from Idaho seed potato tested in the winter grow-out. We again observed clustering of recombinant PVY isolates, especially PVY-NE11, with specific producers. Hence, in 2014, we alerted producers with high proportion of PVY^{NTN} and PVY-NE11 in their lots. These attempts were successful – P. Nolte received positive feedback from producers who removed their seed from the system.

Table 1. Summary of the 2013 winter grow-out testing.

692	Samples tested	100%
588	PVY-positive	84%
37	Typed PVY ^O	5%
29	Typed PVY ^{N:O}	4%
404	Typed PVY ^{N-Wi}	59%
25	Typed PVY-NE11	4%
74	Typed PVY ^{NTN}	11%
1	Typed PVYN	0.1%
25	Typed as mixed/unclassif.	4%

All tests during the 2013, 2014, and 2015 seasons were conducted using the immunocapture (IC) RT-PCR methodology (Chikh-Ali et al., 2013), and resulted in further improvements of the efficiency of PVY testing/typing – the proportion of PVY-positives was at or above 84% for all the seasons. This reduced the number of samples subjected to the expensive RT-PCR analysis, and focused it only on PVY-positives.

In 2014, 754 samples were analyzed, received from Waialua, HI. All samples were subjected to an initial ELISA test, and of these only PVY-positives were further subjected to our IC-RT-PCR typing.

Table 2. Summary of the 2014 winter grow-out testing.

754	Samples tested	100%
710	PVY-positive	94%
98	Typed PVY ^O	14%
20	Typed PVY ^{N:O}	3%
439	Typed PVY ^{N-Wi}	62%
120	Typed PVY ^{NTN}	17%
34	Typed as PVY-NE11	5%
24	Typed mixed/unclassif.	4%

For the 2014 season, the proportion of non-recombinant PVY^O strain relative to other, recombinant strains, rose slightly comparing to the 2013 data. Recombinant strains represented 82% of all PVY-positive samples from Idaho seed potato tested in the winter grow-out this year. PVY^{NTN} strain proportion increased slightly as well: 14% in 2014, versus 11% in 2013. Once again, the observation on clustering of recombinant PVY isolates, especially NE-11, with specific producers was confirmed. We continued to alert producers having high proportion of PVY^{NTN} and other strains associated with tuber necrosis.

In 2015, 908 samples were analyzed, received from Waialua, HI. All samples were subjected to an initial ELISA test, and of these only PVY-positives were further subjected to our IC-RT-PCR typing (see Chikh-Ali et al., 2013).

Table 3. Summary of the 2015 winter grow-out testing.

908	Samples tested	100%
778	PVY-positive	86%
29	Typed PVY ^O	4%

8	Typed PVY ^{N:O}	1%
513	Typed PVY ^{N-Wi}	66%
159	Typed PVY ^{NTN}	20%
23	Typed as PVY-NE11	3%
46	Typed mixed/unclassif.	6%

In the 2015 season, the proportion of non-recombinant PVY^O strain relative to other, recombinant strains, dropped significantly comparing to the 2014 data. Recombinant strains represented now 90% of all PVY-positive samples from Idaho seed potato tested in the winter grow-out this year. PVY^{NTN} strain proportion increased slightly again: 20% in 2015, versus 11% in 2013 and vs 17% in 2014. We continued to alert producers having high proportion of PVY^{NTN} and other strains associated with tuber necrosis.

- **Goals and Outcomes Achieved**

The entire potato seed crop submitted for the Idaho winter grow-out test, over 800 seed lots each of the three seasons, was subjected to testing for the PVY presence, and subsequent typing of the PVY-positives to type. The project sought to determine the incidence of the recombinant PVY strains in Idaho potato, and this objective was achieved.

- The longer-term objective of the project was to determine the dynamics of the recombinant PVY incidence, e.g. if and how the proportion of different recombinant strains circulating in Idaho potato may be changing over time. Based on this 3-year study the proportion of a non-recombinant O type decreased several times relative to the previous period of 2009-2012, staying at 5% or below for two years out of 3: 5% in 2013 and 4% in 2015. Only in 2014 PVY^O prevalence reached 14%. PVY^{NTN} strain prevalence was found increasing from 11% in 2013 to 17% in 2014, and to 20% in 2015. Another recombinant strain, PVY^{N-Wi} was found expanding slightly, from 59% in 2013 to 66% in 2015.
- This project (and the related previous projects funded in 2009-2012) created the first comprehensive data set on PVY strain composition, their geographical and cultivar distribution, and their dynamic changes from year-to-year in Idaho seed potato.
- All the data collected from the winter grow-outs in 2013-2015 were broken down by seed lots and cultivars, and presented to the Idaho Potato industry at Idaho Seed Potato Seminars in 2014-2016 and at Idaho Potato Conferences in 2014-2016. These took place in January, every year during the week of the MLK day, in Pocatello, ID. The results of the surveys and strain typing composition were also presented and disseminated during annual meetings of the Idaho Association of Plant Protection in 2014-2015, these took place the first week of November in Jerome, ID. The entire dataset was compiled into a secure database maintained in the Plant Virology Laboratory in Moscow, ID – this is used to communicate information on changes in virus strain prevalence to potato industry and to individual growers.

Beneficiaries

Beneficiaries are expected to be Idaho potato seed growers, as well as all potato growers, and entire potato industry in the state. The project focused on the main virus pathogen affecting potato crop in the state of Idaho. It affected the entire potato industry which employs over 15,000 potato-related jobs in the state. These are direct beneficiaries of the research conducted. ~~Ultimately, consumers will benefit through more affordable prices and better quality of fresh market potato. Understanding of the PVY strain populations and circulation in the state will help in development of resistant varieties and guide growers in choices of grown cultivars.~~

Lessons Learned

The strain composition of PVY isolates circulating in Idaho seed potato does not remain static, and changes year-to-year. The precipitous drop in the non-recombinant PVY⁰ isolates observed for the past 6-7 years is of concern to the industry, since this is the ordinary PVY type that can be effectively managed through potato seed certification. The observed trend may lead to complete displacement of PVY⁰ with other, recombinant strains of the virus.

After 3 years of decrease in prevalence of PVY^{NTN} in 2011-2013, an increase in the proportion of necrotic PVY^{NTN} isolates, from 11% in 2013 to 20% in 2015, was registered. This is, of course, not good news; however, the proportion of PVY^{NTN} isolates still remains below the levels observed during 2009-2010 seasons.

The strategy of alerting producers with PVY^{NTN} in their seed lots is effective and there is a plan to continue these eradication efforts targeting tuber necrotic strains of PVY.

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Additional Information

Popular press articles:

- Olsen, N. and Karasev, A. (2015) Going Viral. Discerning among common virus-induced diseases. *Potato Grower Magazine*, September 2015; p. 32.

Peer-reviewed scientific publications:

Chikh-Ali, M., Alruwaili, H., Vander Pol, D., and Karasev, A.V. (2016) Molecular characterization of recombinant strains of *Potato virus Y* from Saudi Arabia. *Plant Disease* **100**: 292-297.

Chikh-Ali, M., Bosque-Perez, N., Vander Pol, D., Sembel, D., and Karasev, A.V. (2016) Occurrence and molecular characterization of recombinant *Potato virus Y^{NTN}* (PVY^{NTN}) isolates from Sulawesi, Indonesia. *Plant Disease* 100: 269-275.

Chikh-Ali, M. and Karasev, A.V. (2015) Immunocapture-Multiplex RT-PCR for the Simultaneous Detection and Identification of Plant Viruses and Their Strains: Study Case, *Potato virus Y* (PVY). Chapter 14. In: *Plant Pathology: Techniques and Protocols, Methods in Molecular Biology* (C. Lacomme, editor), Springer: New York, NY. Vol. 1302: 177-186.

Chikh-Ali, M. and Karasev, A.V. (2015) *Potato virus Y*. Chapter 7. In: *Virus Diseases of Tropical and Subtropical Crops* (P. Tennant and G. Fermin, eds), CABI International: Wallingford, Oxford, UK.

Benedict, C., McMoran, D., Inglis, D., and Karasev, A.V. (2015) Tuber symptoms associated with recombinant strains of *Potato virus Y* in specialty potatoes under northwestern Washington growing conditions. *American Journal of Potato Research* 92: 593-602. Fig. 1 of this paper has been selected for the cover of the October issue of *American Journal of Potato Research*.

Rowley, J.S., Gray, S.M., and Karasev, A.V. (2015) Screening potato cultivars for new sources of resistance to *Potato virus Y*. *American Journal of Potato Research* 92: 38-48. – Fig. 8 of this paper has been selected for the cover of the February issue of *American Journal of Potato Research*.

Chikh-Ali, M., Rowley, J.S., Kuhl, J.C., Gray, S.M., and Karasev, A.V. (2014) Evidence of a monogenic nature of the *Nz* gene conferring resistance against *Potato virus Y* strain Z (PVY^Z) in potato. *American Journal of Potato Research* 91: 649-654. An image related to this paper has been selected for the free image page of the December issue of *AMERICAN JOURNAL OF POTATO RESEARCH*

Quintero-Ferrer, A., Robles-Hernandez, L., Gonzalez-Franco A.C., Kerlan, C., and Karasev, A.V. (2014) Molecular and biological characterization of a recombinant isolate of *Potato virus Y* from Mexico. *Archives of Virology* 159: 1781-1785.

Impact of Grapevine Viruses on Idaho Grape Quality

Subrecipient

USDA-ARS

Project Summary

This work was conducted in collaboration with Idaho winegrape growers, and we acknowledge their aid, particularly in allowing us sample from their vineyards. 'Merlot', 'Cabernet Sauvignon', 'Tempranillo', 'Syrah', and 'Cabernet franc' leaves and clusters were sampled for growing seasons 2014, 2015, and 2016 ($n > 312$). Virus testing was completed on the leaves collected from growing seasons 2014 and 2015 by UI graduate student B. Thompson, although these samples are currently undergoing secondary testing with new primers. From this work, we confirmed that *Grapevine leafroll associated viruses* (GLRaV)-1 and -3, *Grapevine viruses* A and B, *Grapevine fleck virus infections*, and *Grapevine red leaf blotch* are present in Idaho vineyards. It is too early to tell how exactly fruit qualities from virus positive vines in this region will be impacted compared to those of healthy vines. One commercial vineyard was found 100% positive for GLRaV, which likely explains this vineyard's grape ripening and yield problems. Both production issues are known possible consequences from GLRaV-3 infections. Samples continue to be stored frozen until all tests are complete. Identified positive-infected vines versus healthy vines make up the vine-pairs that will be used for the chemical component analyses. This remains an ongoing project.

Grapevine viruses represent a major concern to well established viticulture regions, but risks to Idaho's industry were unknown until this work was funded. In the US, Idaho's winegrape industry is considered fairly young when compared to the predomination growing regions of California, Washington, Oregon, and New York. Industry loss prevention protocols are not yet customary in this region, where new or re-plantings sometimes utilize cuttings from virus infected vines rather than purchasing new cuttings from a virus-free certified nursery. Some grapevine viruses are detrimental to grapevine health, fruit quality, and ultimately wine quality. Others cause only minor problems. Grapevine virus infection influences fruit quality differently and is dependent on climate regime, soil type, cultivar, etc. The first step in resolving this issue is determining the presence of the virus in Idaho. After discovery, the grapevine viruses are identified, and then assessments can reveal how they influence Idaho grown winegrapes.

This work was the first to identify the presence of grapevine viruses in Idaho commercial vineyards. Improvements were also made in the molecular diagnostic techniques that distinguish the different strains of virus as the study progressed. From this work, we confirmed that *Grapevine leafroll associated viruses* (GLRaV)-1 and -3, *Grapevine viruses* A and B, *Grapevine fleck virus infections*, and *Grapevine red leaf blotch* are present in Idaho vineyards.

This work continues in our 2014 funded grant proposal.

Project Approach

A minimum of twelve vines per cultivar (six comparison pairs) available at commercial vineyards were selected based on visual signs, consisting of six control-healthy and six of suspected infection, which are currently going through second round testing for virus infection. Vines that exhibited signs of potential infection with the new *Grapevine red leaf blotch* were sampled with adjacent healthy looking vines as well. Dr. Karasev's group is refining their extraction and virus testing techniques. Fruit samples were

harvested from virus-tested vines at commercial harvest and will be analyzed once the virus work is complete. This work is in progress.

Goals and Outcomes Achieved

The original goal of this proposed work was to determine the current grapevine virus status, and that relationship to fruit quality, while establishing the metabolite baseline for Idaho wine grapes. Please refer to project summary. This research is taking place with additional funding from ISDA 2014 for completion in 2017. We have discussed our findings with ID grape growers and winemakers during the ID wine commission's annual, and individual grower, meetings. Graduate student (B. Thompson) has finished all of his course works and experiments, and is currently in the final phase (writing thesis and final defense) of obtaining his Master degree.

Presentations (total 2):

Lee, J., and Karasev, A.V. "Impact of grapevine viruses on grape quality", Idaho Grape Growers and Wine Producers Annual Meeting, Garden City, ID, February 2016. [*invited*] (~60 attendees)

Thompson, B.D., Nikolaeva, O.V., Lee, J., and Karasev, A.V. "Grapevine viruses in Idaho", Idaho Grape Growers and Wine Producers Annual Meeting, Garden City, ID, February 2016. [*invited*] (~60 attendees)

Individual communications with growers

Virus results from samples taken from the commercial vineyards were discussed with vineyard owners and managers individually (~10 individuals; 1 vineyard produces the majority of the state's winegrapes).

Publications (1):

Kanuya, E., Clayton, L.A., Naidu, R.A., and **Karasev, A.V.** (2012) First report of Grapevine fleck virus in Idaho grapevines. *Plant Disease*. 96:1705-1705.

Graduate student (B. Thompson) is currently working on thesis and additional manuscript from this work.

Beneficiaries

Grape growers and winemakers will benefit from vine virus status information, since identification of the virus present in Idaho grape vineyards is the first step in stopping economic losses caused by grapevine viruses.

Virology researchers will benefit from molecular diagnostic techniques developed from this work, since we have found a rare GLRaV clone (this work is continuing in our 2014 funded grant proposal).

Virology researchers will benefit from molecular diagnostic techniques developed from this work. We have found a rare GLRaV clone as well (this work is continuing in our 2014 funded grant proposal).

Currently, GLRaV can only be eliminated by vine roguing, which could cost a vineyard owner \$5,000-\$16,000 per acre.

Lessons Learned

Interagency administrative paperwork requirements delayed receiving and obtaining access to grant funds. This caused a postponement of initially spending and project start date. This issue that remains unresolved.

Grower communications require improvement. Following the first year of sampling, one grower removed all tagged study vines from this experiment and replanted with new certified vines. This discovery eliminated second year data collection, which is the minimum standard for horticultural research publications.

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Additional Information

Presentations

Lee, J., and Karasev, A.V. "Impact of grapevine viruses on grape quality", Idaho Grape Growers and Wine Producers Annual Meeting, Garden City, ID, February 2016. [*invited*]

*Thompson, B.D., Nikolaeva, O.V., Lee, J., and Karasev, A.V. "Grapevine viruses in Idaho", Idaho Grape Growers and Wine Producers Annual Meeting, Garden City, ID, February 2016. [*invited*]*